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2015 Volume 47

Blended Learning Strategy: Application for Orthoptic Teaching

Use of MAIA microperimetry in retinal practice

NDIS and the functional impact of vision

Amblyopia treatment in older patients

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Book Chapter: Murphee AL, Christensen LE. Retinoblastoma and malignant tumors. In: Wright KW, Spiegel PH, editors. Pediatric Ophthalmology and Strabismus. 2nd Ed. New York: Springer; 2003. p. 584-589.

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Editorial

Blended Learning Strategy: Application for Orthoptic Teaching

The internet has changed the way we conduct our lives. Human communication, accessing news and media, personal finances and shopping are just some of the things we do differently in the digital age. As a result of this electronic world we find ourselves in, the way we learn and therefore teach has also had to adapt to ensure a modern approach.

In response to this, many universities across the globe are modifying the way they offer education to students and orthoptic training has not been immune to the challenges of keeping up with the digital age. Information is more easily accessible and instantaneous and therefore the way students engage with learning has been transformed. Students require increased stimulation and encouragement to be active participants in their learning experience.[1] Activities and conditions which stimulate students and therefore generate high quality learning is termed 'student engagement' and one way to achieve this is through the *Blended Learning approach*.[2] Blended learning is the integration of traditional classroom face-to-face learning with an online learning experience.[3]

La Trobe University in Melbourne has launched the 'Future Ready' and 'Distinctive Education Project' initiatives and this is influencing the way we design classes for orthoptic students, both in terms of delivery and also assessment.

The orthoptic program at La Trobe mostly utilises an Enquiry-Based Learning (EBL) approach which was adopted in 2009 and is a teaching strategy where students are presented with a problem and learning is directed by the student through a process of research-oriented enquiry to resolve the problem. Whilst most of the program is delivered face to face with all subject materials available online, several subjects have been designed in *Blended Learning* mode (Concomitant and Incomitant Strabismus; Low Vision Rehabilitation) or solely online (Human Vision and Function; Models of Eye Service Delivery). The orthoptic program also integrates a number of innovative approaches to facilitate student engagement including:

i. The development of a simulator (Ocular Motility Virtual Environment (OMVE)) which is designed to simulate eye movement disorders and provide students with an opportunity to examine 'simulated patients' in a safe environment;

ii. The development of online interactive tools such as the 'Vertometry Learning Object' that utilises multimedia (including video, audio, text and animations) to develop clinical skills in measuring the strength/prescription of glasses; and

iii. Utilisation of simulated patients to develop communication skills.

Several of our subjects include assessments beyond traditional assignment and exams. These aim to develop student understanding of discipline-specific concepts or skills using a variety of modes, technologies and media in an integrated manner. These have been developed in consultation with educational designers. For example, as part of the introductory *Clinical Practice* subject, students are required to produce an instructional video of a clinical skill for peer review and to develop or improve online resources on this technique. In order to facilitate the flexible learning experience, to engage students and to keep up with the digital learning age, we utilise a number of internet-based teaching technologies. These include providing an online presence for all subjects; lectures are recorded using the *Echo360* program in addition to *iTunesU; Pebblepad* allows students to document their observations and reflections whilst on clinical placement, *Wikiversity* facilitates content delivery and some student assessment incorporates *Wikipedia* or YouTube to present and update clinically relevant content.

As Garrison,[3] p97, so eloquently states "What makes blended learning particularly effective is its ability to facilitate a community of inquiry. Community provides the stabilising, cohesive influence that balances the open communication and limitless access to information on the Internet." The orthoptic discipline at La Trobe University has made substantial progress in terms of redesigning the learning approach and the academic benefit of this is significant. As we continue to strive for excellence in teaching and further develop our approach we are mindful to evaluate the effectiveness of *Blended Learning* in the sense of student satisfaction, performance (both theoretical and clinical) and measure achievement of learning goals. We are confident that with this approach and innovative thinking, our orthoptic graduates will be 'Future Ready' and capable of competently addressing the challenges of the workforce as they transition into it.

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Letter to the Editor: Manifest Strabismus in Children Previously Diagnosed with Pseudostrabismus

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Pseudostrabismus is often diagnosed in children with the appearance of a squint but no genuine ocular deviation. Recent studies have suggested a possible association with the subsequent development of true strabismus and amblyopia.[1-3] We aimed to establish the incidence of true strabismus in children under the age of 36 months initially diagnosed with pseudostrabismus seen in our outpatient clinics over the last decade.

Patients were identified through a retrospective computer-based search using the terms 'pseudostrabismus', 'pseudosquint', and 'pseudoesotropia'. All children under the age of 36 months who were given one of these diagnoses between April 2001 and September 2012 were included. The case notes of those who were documented in subsequent outpatient clinic letters to have a manifest strabismus were then reviewed.

A total of 199 children met the inclusion criteria of which 112 (56.3%) were boys. The median age at presentation was 7.5 months (range 2 to 35 months). One-hundred-and-forty-six (73.3%) had a documented follow-up appointment. Overall, 12 (6.0%) children were subsequently diagnosed with a manifest strabismus: there were seven cases of non-accommodative esotropia, three of fully or partially accommodative esotropia, and two of exotropia. Of the children who developed a manifest strabismus, three had a family history of strabismus or amblyopia (although only one in a first-degree relative), and one was documented as having broad epicanthic folds. A specific parental concern about squint was documented in nine of the twelve cases and poor co-operation was recorded in two. The median time interval between diagnosis of pseudostrabismus and true strabismus was 7.5 months (range 3 to 12 months). Three of the children showed evidence of amblyopia in the deviating eye at follow-up (1.5% of the whole cohort).

The incidence of true strabismus in this patient group was higher than that expected based on population data (2.1-3.3%, from the Baltimore Pediatric Eye Disease Study),[4] and consistent with reports from elsewhere.[2] This may have been because subtle deviations were missed at the time of initial review owing to the inherent challenges of assessing preverbal children, or because intermittent deviations, which had been noted by the parents, were not manifest during the first assessment. One limitation of this retrospective analysis is the significant proportion of children who did not have documented follow-up (26.6%). It is possible therefore, that our figure of 6.0% may represent an underestimate of the true proportion of the cohort who developed a manifest deviation. Furthermore, given the low number of patients who were later diagnosed with true strabismus, it was not possible to ascertain risk factors for its development, and future large scale - ideally prospective studies will be required to identify any such risk factors. All children who developed a true strabismus in our study did so within twelve months of their initial consultation, with a 25% incidence of amblyopia. We recommend a follow-up period of one year, or until a satisfactory unilateral LogMAR visual acuity is obtained, as appropriate for children referred with suspected strabismus who are found to be orthoptically satisfactory on initial examination.

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Use of MAIA Microperimetry in Routine Tertiary Retinal Practice

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ABSTRACT

Background: Microperimetry is well established as a psychophysical outcome measure in clinical trials and is increasingly used in routine retinal practice for patients with visual symptoms. However, there is sparse evidence indicating the value of microperimetry in the clinical setting as distinct from the research setting. The aim of this study was to describe the usefulness of the MAIA microperimeter in tertiary retinal practice.

Method: A total of 80 eyes of 48 patients presenting to a private tertiary medical and surgical retina practice were retrospectively reviewed. Sixty-two eyes had retinal or macular pathology and nine had no retinal or macular pathology clinically present. Diagnosis classification information was missing for nine eyes. Visual acuity, clinical examination, optical coherence tomography (OCT) and Macular Integrity Assessment (MAIA) microperimetry were performed, and presenting symptoms recorded. Primary outcome measures were best corrected visual acuity (BCVA; LogMAR letters), macular integrity index (MII), average threshold sensitivity (ATS; dB) and test duration (minutes). Secondary outcome measures were pattern of visual field loss and fixation stability.

Results: MII was strongly related to BCVA and ATS (Spearman's rho = -0.305, $p = 0.006$; $r = -0.767$, $p < 0.0001$ respectively). Four groups were identified, including three abnormal groups and one normal group: i) focal scotoma (21 eyes); ii) reduced average threshold with poor fixation (31 eyes); iii) reduced average threshold with normal fixation (20 eyes); and iv) normal (8 eyes). MII ($p < 0.0001$) and ATS ($p < 0.0001$) were significantly different between abnormal and normal eyes. Overlap was present in results of abnormal and normal eyes, and no sole microperimetry outcome measure was unequivocally able to distinguish between the three abnormal groups, or between normal and abnormal eyes.

Conclusions: MAIA MII is strongly related to ATS and BCVA. Different patterns of visual field loss are described, but no single microperimetry parameter distinguished normal from abnormal patients. It is crucial to interpret microperimetry results appropriately in the clinical context.

Keywords: Microperimetry, fundus perimetry, macular integrity analysis, scotoma, retinal sensitivity

INTRODUCTION

Microperimetry (fundus perimetry) is a psychophysical diagnostic technique correlating sensitivity threshold of individual points on the retina with ophthalmoscopic retinal appearance in real time. Location of fixation sites at the fovea and macula enable accurate follow-up examination (test-retest) as stimuli are projected directly onto the retina and the same retinal point is monitored via eye-tracking.[1,2]

The earliest microperimetry measurements were made manually by projecting visual stimuli onto the retina through a direct ophthalmoscope.[3] The first commercially available device projected a stimulus under Scanning Laser Ophthalmoscope (SLO) observation (Rodenstock Instruments, Munich, Germany), however full automation and follow-up comparison was not possible.[4] In 2002, the first fully-automated microperimeter (MP-1) was introduced.[5] The MP-1 microperimeter (Nidek Technology, Gamagori, Japan) enabled automatic real-time alignment of fixation and a larger fundus field of view compared with the SLO (MP-1 = 44° × 36°; SLO = 33° × 2°). Normative age-related threshold data and test-retest accuracy have been published for the MP-1 microperimeter.[6,7] Recent advances have combined the investigation of structural changes in the retina using optical coherence tomography (OCT) with microperimetry: Optos OCT/

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SLO microperimeter (Optos, Dunfermline, Scotland)[8] and OPKO/OTI microperimeter (OPKO Instrumentation, Florida, USA).[9] Normative age-related threshold data and test-retest accuracy are currently under investigation.[9,10]

The Macular Integrity Analysis microperimeter (MAIA, CenterVue, Padova, Italy)[11] further advanced SLO technology by enhancing imaging and offering a wider sensitivity range (0-36 dB) and software improvements. Whilst the MAIA cannot overlap OCT images with microperimetry results, it does have several useful features in that it captures real-time black and white fundus images continuously throughout an examination and quantifies the stability of a patient's fixation or retinal locus. Results are known to correlate with inner plexiform layer thickness measured on Cirrus OCT scanning.[12] However, to date, limited normative age-related[13] and intra-session test-retest data have been reported.[14]

The MAIA microperimeter projects stimuli directly onto the retina in random order using either a supra-threshold or a 4-2 staircase strategy to accurately measure macular threshold sensitivity at 37 or 61 pre-determined retinal locations over the central 10° of the retina.[15] Whilst these pre-set examination patterns are most commonly used, custom configuration of different patterns is also possible and may be useful in both the clinical and research settings. Perimetric stimuli are equivalent to a Goldmann size III target and the maximum stimulus intensity is 1,000 apostilbs (asb). MAIA microperimetric outputs include average threshold sensitivity (ATS), fixation stability, and macular integrity index (MII). Average threshold represents the arithmetic mean of all threshold sensitivity responses, recorded in decibels (dB). Fixation location is automatically evaluated by the microperimeter. Throughout testing, an automated eye-tracking system registers eye movements 25 times per second and plots the distribution over the SLO fundus image, adjusting stimulus projection location according to deviations in eye position. Fixation stability is classified as 'stable', 'relatively unstable', or 'unstable' depending on the percentage of fixation points made within two circles of 1 and 2 degree radius, respectively from the geometrical centre of all fixation points. A unique

Table 1. Examples of the use of microperimetry in describing ocular conditions and their response to treatment

Subspecialty	Diagnosis	Sub-classification
Retina	Retinal dystrophies	Retinitis pigmentosa[17] Vitelliform macular dystrophy[18] Stargardt fundus flavimaculatus[19] Goldmann-Favre syndrome[20] Gyrate atrophy[21] X-linked retinoschisis[22] Occult macular dystrophy[23]
	Age-related macular degeneration	Atrophic[24-27] Neovascular[28]
	Retinal vein occlusion	Cystoid macular oedema in branch retinal vein occlusion[29-31] Cystoid macular oedema in central retinal vein occlusion[32]
	Diabetic eye disease	Diabetic macular oedema[33]
	Inflammatory retinal conditions	Acute zonal occult outer retinopathy[34] Unilateral acute idiopathic maculopathy[35] Cystoid macular oedema in uveitis[36]
	Other retinal conditions	Macular telangiectasia type I and II[37,38] Hydroxychloroquine retinal toxicity[39] Central serous chorioretinopathy[40,41] Myopic choroidal neovascularisation[42] Photic maculopathy[43]
	Vitreo-retinal surgery	Retinal detachment[44] Macular hole[45] Epiretinal membrane peel[46]
Glaucoma		Open-angle glaucoma[47,48] Angle-closure glaucoma[47] Advanced glaucoma[48,49]
Neuro-ophthalmology[50]		Multiple sclerosis[51] Optic disc oedema Optic atrophy Optic neuropathy Leber's hereditary optic neuropathy Thyroid-associated orbitopathy

output of the MAIA microperimeter is the MII, a proprietary statistical parameter that is calculated by incorporating the patient's age, ATS and fixation stability index.[2] It is derived by comparison with the manufacturer's normative data and describes the likelihood of threshold values differing significantly from normal values. The basis of MII calculation is not published. Macular integrity is reported as 'normal' (loss no greater than 40%), 'suspect' (loss between 40 and 60%), or 'abnormal' (loss greater than 60%).[11]

Recognised problems using MAIA microperimetry are similar to standard automated perimetry and are inherent in psychophysical testing. These include familiarity with testing procedures, patient compliance and understanding, sensitivity to patient movement, the need for undilated pupils during the test, in addition to standardised background lighting, and problems with mesopic background.

Microperimetry has been extensively used as a research tool[1] in phenotyping and monitoring treatments for diverse retinal conditions, and to a lesser extent glaucoma and neuro-ophthalmology (Table 1). In addition, microperimetry is commonly used in teaching low vision patients to improve visual function.[16] However, microperimetry use differs in clinical practice where patients present with symptoms, the diagnosis may not be immediately apparent and there is no opportunity for test-retest to validate results. Therefore, the aim of this study is to describe the usefulness of MAIA microperimetry in patients with visual symptoms in tertiary retinal practice.

METHOD

Design

This study was designed as a retrospective, non-randomised observational case series. Consecutive patients presenting to a retinal clinic who were tested with MAIA microperimetry as part of routine care were identified from records between December 2012 and October 2013 at a private tertiary ophthalmic practice. Included were cases of all age groups and all visual acuity levels, with the presence and type of retinal disease not specified as a criterion. No patient had previous experience in using the MAIA microperimeter, however some patients had prior experience in other types of visual field testing such as the Humphrey Visual Field Analyser. All procedures and protocols conformed to the provisions of the Declaration of Helsinki 1995, as revised in Edinburgh 2000, and patients provided informed consent for all testing procedures used.

Procedure

The chief complaint or presenting symptom of each participant was recorded. All participants underwent routine clinical examination. Best corrected visual acuity (BCVA) measurements were performed with either back-illuminated Snellen or Early Treatment of Diabetic Retinopathy Study (ETDRS) charts, placed at 6 and 4 m, respectively. Snellen fractions were converted to their equivalent score in logarithm of minimum angle of resolution (LogMAR) letters. Spectral-domain OCT macular scans were acquired using the Cirrus HD-OCT (Carl Zeiss Meditec, Dublin, CA) or Spectralis HRA + OCT (Heidelberg Engineering, Heidelberg, Germany). Dilated fundus examination was conducted by one of two retinal ophthalmologists (HM or WH) and the diagnosis, if any, was recorded.

All participants underwent microperimetric examination using the MAIA microperimeter by one of four trained examiners. Indication for testing was to assist in understanding presenting symptoms and disease. Testing was performed undilated. When pupils were dilated prior to requesting microperimetry, patients attended for microperimetry testing at a subsequent appointment. When both eyes were assessed, microperimetry was performed in the two eyes on the same day. The right eye was always tested first by convention and several minutes rest allowed between testing. Microperimetry was conducted in a darkened room as recommended by the manufacturer and participants were dark adapted for between 5 and 10 minutes. This dark adaptation time reflects the use of the MAIA in clinical practice and time allowance between patients and tests. Refractive correction was not worn as the refractive status of all participants was within the range accounted for by the automatic focus of the SLO (-15 to +10 dioptres).

Standard factory-set parameters were used with respect to the fixation target, stimuli and background luminance. A red circular fixation target measuring 1° in diameter was used. White Goldmann size III stimuli were presented for 200 milliseconds against a white background of 1.27 cd/m^2, using an expert 4-2 staircase strategy. A radial stimulus array was used with fixed distance between stimuli in the array. The maximum stimulus luminance was 318.47 cd/m^2 and stimulus attenuation ranged from 0 to 36 dB. The examiner remained present in the room at all times during testing.

Outcome measures

Primary outcome measures were BCVA (LogMAR letters), macular integrity index (MII), average threshold sensitivity (ATS; dB) and test duration (minutes). Secondary outcome measures were fixation stability and pattern of visual field loss. The pattern of visual field loss was categorised (by HM or WH) as 'full', 'generalised depression', 'focal scotoma' or 'ring scotoma'. Classification by MAIA algorithms of MII and ATS into 'normal', 'suspect' and 'abnormal' was not recorded. Demographic information pertaining to patient age and gender was also collected.

Table 2. Summary data for patients undertaking MAIA microperimetry

Clinical group	**Group 1** **Focal scotoma**	**Group 2** **Reduced average threshold & poor fixation**	**Group 3** **Reduced average threshold & normal fixation**	**Group 4** **Normal threshold & fixation**	**Comparison of abnormal group & normal group**	**Comparison between abnormal groups**
	ABNORMAL			**NORMAL**	**p-value**	**p-value**
Number of eyes	21	31	20	8		
	72			8		
Age mean (years) (Range, SD)	63 (26 - 90, ±19.45)	79 (38 - 92,±10.40)	80 (69 - 91, ± 6.40)			**p=0.001**
	75 (26 - 92, ±14.80)			63 (38 - 74, ±11.82)	**p=0.006**	
BCVA mean (# letters read correctly) (Range, SD)	76 (28 - 95, ±15.86)	63 (26 - 88, ±19.46)	68 (49 - 85, ±68.25)			**p=0.018**
	68 (26 - 95, ±17.24)			82 (69 - 90, ±8.21)	**p=0.0017**	
Macular integrity index median (Interquartile range) Range	100 (99.5 - 100) 49.9 - 100	100 (97.3 - 100) 1.3 - 100	99.95 (99.1 - 100) 72.7 - 100			p=0.80
	52 (16.2 - 65.8) 1.3 - 100			52 (16.2 - 65.8) 10 - 93.1	**p=0.000**	
Average threshold median (dB) (Interquartile range) Range	22.3 (16.9 - 24.6) 7.8 - 26.6	16.1 (3.4 - 23.7) 0 - 26.9	20.85 (14.8 - 22.3) 0 - 25.9			p=0.12
	20.85 (11.95 - 23.75) 0 - 26.9			27.9 (26.8 - 28.5) 24.6 - 29.5	**p=0.000**	
Test duration mean (minutes)	OU 6.12 OD 6.09 OS 6.15	OU 7.27 OD 8.54 OS 6.46	OU 5.93 OD 5.81 OS 6.07			**p=0.004**
	OU 6.56 OD 6.89 OS 6.28			OU 5.71 OD 5.97 OS 5.26	**p=0.036 (OU)**	

Following observation of the raw data, eyes were divided into 'normal' or 'abnormal' groups by either of the trained vitreoretinal ophthalmologists (HM or WH). Normal eyes comprised eyes thought by the examiners to be normal and symptoms not related to macular pathology, or unaffected second eyes. Normal eyes fulfilled each of the following four criteria: i) no retinal or macular pathology clinically present; ii) normal ATS; iii) full field; and iv) stable fixation. Abnormal eyes included those eyes that fulfilled two or more of the following criteria: i) presence of retinal or macular pathology; ii) reduced ATS; iii) either focal or diffuse field loss; or iv) fixation either unstable, relatively unstable or stable. The abnormal group was further sub-divided into three groups dependent on pattern of visual field loss and stability of fixation (Figure 1, Table 2).

Data analyses

All patient data was de-identified prior to statistical analysis. None of the data was normally distributed, therefore non-parametric statistical tests were used for analysis.

Receiver operating characteristic (ROC) curves were constructed to investigate the ability of ATS and MII to predict normal versus abnormal status.

Predictors of BCVA were analysed with linear regression. Categorical values of age, gender, MII, ATS, test duration and fixation status were considered for inclusion in the model. Predictors of normal versus abnormal status were analysed with logistic regression. Two separate models were developed, one for the entire sample and one for those with normal ATS values. Categorical values of age, gender, MII and test duration were considered for inclusion in the model for the entire sample. ATS was added as a continuous variable in the model for those with normal ATS values.

A forward stepwise selection process (with a p-value of 0.05 to enter) along with the Karlson, Holm and Breen (KHB) method of examining confounders (using a 20% coefficient confounding percentage cut-off) was used to select covariates for inclusion in each of the models. All analyses were performed using either SPSS v21 or Stata v12.

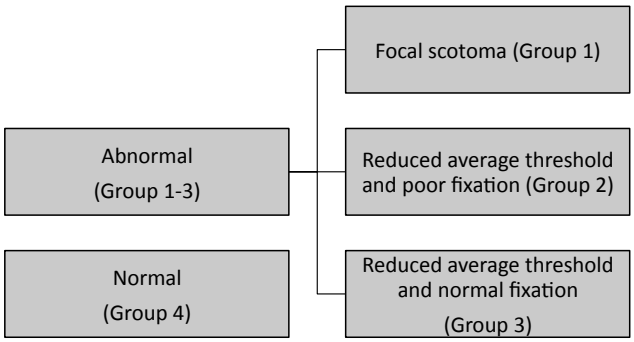

Figure 1. Division of eyes into normal or abnormal (with sub-groups) based on pattern of field loss.

Table 3. Diagnoses of patients undertaking MAIA microperimetry

Diagnosis	Frequency (N)	Percentage
Normal	9	11.3
Plaquenil maculopathy	4	5.0
Atrophic AMD	24	30.0
Neovascular AMD	12	15.0
Epiretinal membrane peel	4	5.0
Macular telangiectasia	2	2.5
Macular hole	3	3.8
Central serous retinopathy	4	5.0
Proliferative diabetic retinopathy	2	2.5
Cystoid macular oedema	1	1.3
Acute zonal occult outer retinopathy	2	2.5
Macular drusenosis	3	3.8
Legionnaire retinopathy	1	1.3
Total	**71**	**88.8**
Missing	9	

RESULTS

Eighty eyes (38 right, 42 left; 56 female, 24 male) of 48 patients presenting to a retinal clinic within a private tertiary ophthalmic practice were retrospectively reviewed (Table 2). Participants were aged 26 to 92 years (mean 73.31 ±15.55).

Of the 80 eyes, 62 had a diagnosis of retinal or macular pathology (Table 3). Nine eyes had no retinal or macular pathology clinically present. Diagnosis classifications were missing for nine eyes. Thirteen diagnoses were identified (Table 3), the most common being age-related macular degeneration (atrophic 30%, neovascular 15%). The most common presenting symptoms were difficulty reading (36.3%), scotoma (15.0%), reduced vision (11.3%) and distortion (10.0%) (Table 4).

Based on the definitions of normal and abnormal outlined previously, eight eyes were identified as fulfilling all of the criteria for 'normal' and as such, were classified into the 'normal' group. The remaining 72 eyes fulfilled two or more of the criteria for 'abnormal' and therefore were classified into the 'abnormal' group. Eyes in the abnormal group were further divided into three sub-groups based on pattern of visual field loss and fixation stability. Table 2 shows the frequency of eyes in these three sub-groups.

The mean age of the normal group was significantly younger (63 ±11.82 years) compared with the abnormal group (75 ±14.80 years) (Mann Whitney: U = -2.76, p = 0.006). Within the abnormal group, Group 1 was significantly younger (63 ±19.45 years) compared with Groups 2 or 3 (79 ±10.40 years and 80 ±6.40 years, respectively) (Kruskal-Wallis: H(3) = 13.9, p = 0.001).

BCVA ranged from 26 to 95 letters (mean 69 ±17.03 letters). On average, the normal group correctly read 14 letters more than the abnormal group and this was statistically significant (Mann Whitney: U = -1.87, p = 0.017). When comparing the abnormal groups, Groups 1 and 3 had better BCVA than Group 2 (Kruskal-Wallis: H(3) = 8.07, p = 0.018).

The distribution of ATS across the four groups is shown in Figure 2 and Table 2. The distribution of values for ATS differed between normal and abnormal eyes (Mann Whitney: U = -4.51, p = 0.000). Group 2 patients (by definition of clinical category) demonstrated lowest reduced average threshold (16.1 dB) and broadest result spread (0 – 26.9 dB) by comparison with other patients, but the three abnormal groups did not differ significantly (Kruskal-Wallis: H(3) = 4.33, p = 0.12).

The distribution of scores for MII was spread across most of the possible values for the normal and abnormal groups

Table 4. Presenting symptoms of patients undertaking MAIA microperimetry

Presenting symptom	Frequency (N)	Percentage
Difficulty reading	29	36.3
Distortion	8	10.0
Asymptomatic	7	8.8
Film over vision	2	2.5
Reduced vision	9	11.3
Deteriorating vision	3	3.8
Monocular diplopia	4	5.0
Scotoma	12	15.0
Glare sensitivity	1	1.3
Floaters	2	2.5
Total	**77**	96
Missing	3	

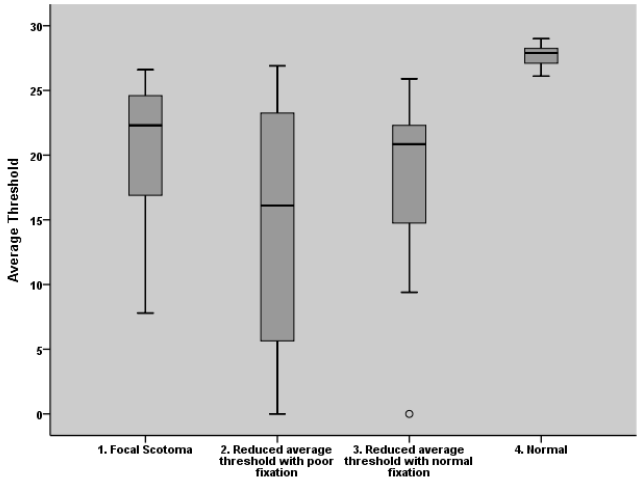

Figure 2. Average threshold sensitivity (ATS) for clinical sub-groups.

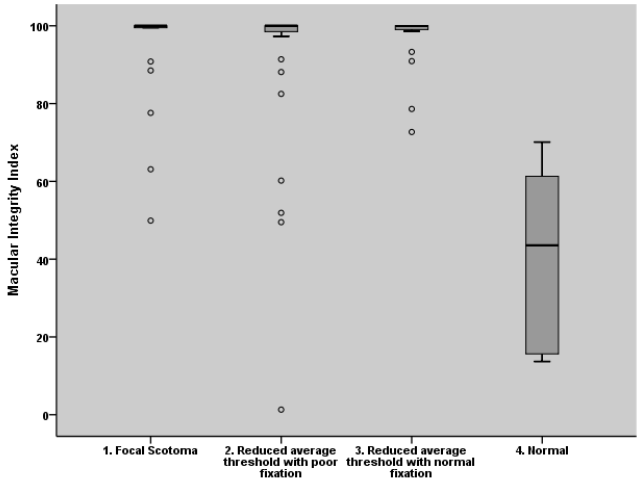

Figure 3. Macular integrity index (MII) for clinical sub-groups.

(Figure 3, Table 2). The distribution of values for MII differed significantly between abnormal and normal eyes (Mann Whitney: U = -4.69, p = 0.000), but MII did not differ significantly within the three abnormal groups (Kruskal-Wallis: H(3) = 0.46, p = 0.80).

Figure 4 shows the relationship between MII and BCVA letters. A statistically significant, albeit weak, relationship was found (Spearman's rank correlation; rho = -0.305, p = 0.006).

The relationship between MII and ATS was examined. Whilst these indices are both calculated from the same sensitivity data, this was done because the algorithm for calculating MII has not been published and so, it was performed as a validation of the algorithm. If no relationship was found, this would cast doubt on the usefulness of the MII. A statistically significant relationship was found between MII and ATS (Spearman's rank correlation; rho = -0.767, p = 0.000) when all groups were combined (Figure 5).

Review of Table 2 shows a useful ATS discriminatory value that has the potential to differentiate normal from abnormal eyes. A discriminatory ('cut-off') value for average threshold of approximately 25 dB (falling somewhere between the range of 24.6 and 26.9 dB) was identified as having the potential to distinguish normal from abnormal status. This cut-off value and/or range might help to delineate normal from abnormal. Upon closer investigation of ATS between the abnormal eyes, it was not possible to discriminate between the three different abnormal groups.

A ROC curve was constructed to further investigate the ability of ATS to predict normal status [Area under the ROC curve (AUROC) = 0.988 (95% CI, 0.967, 1.00), Figure 6a]. Based on this, ATS is a useful predictor in discriminating

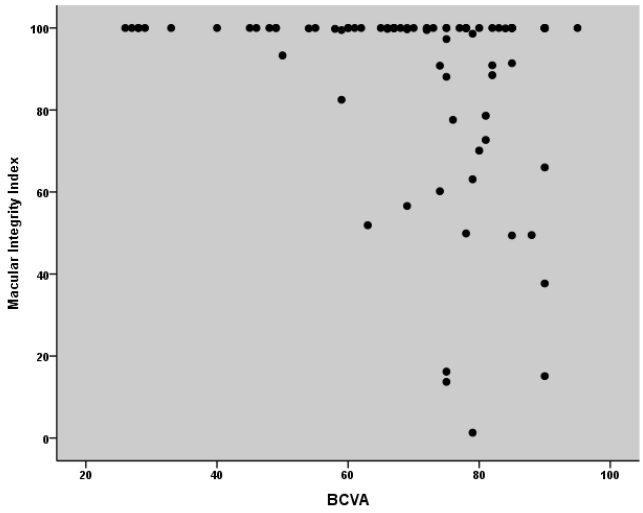

Figure 4. Relationship between macular integrity index (MII) and BCVA letters.

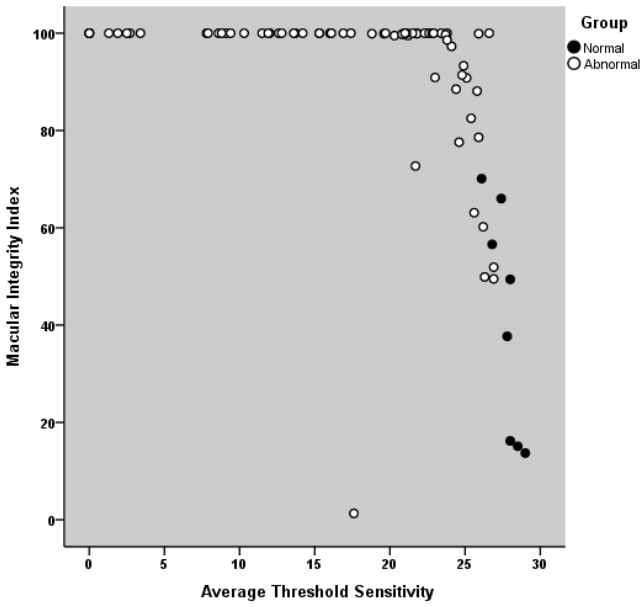

Figure 5. Relationship between macular integrity index (MII) and average threshold sensitivity (ATS), normal versus abnormal group.

normal from abnormal. A ROC curve confirmed that this is also the case for MII [AUROC = 0.964 (95% CI 0.923, 0.100), Figure 6b].

Average test duration for patients, irrespective of eye being tested, was 5.71 minutes (range: 5.08 – 8.53) for those in the normal group and 6.56 minutes (range: 2.44 – 16.39) for those in the abnormal group (Table 2). The average test duration for the normal group was significantly faster than the abnormal group (Mann Whitney: U = -2.09, p = 0.036). Figure 7 shows test duration by eye and by group; the right eye was always tested first. The group with reduced average threshold and poor fixation had larger variation in testing

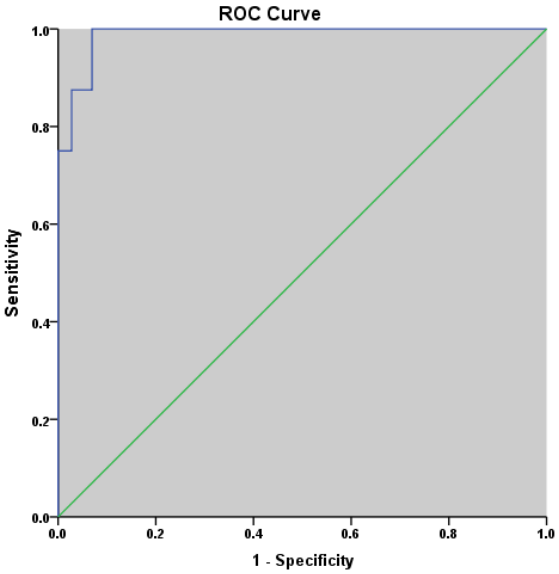

Figure 6a. ROC curve of ability of average threshold sensitivity (ATS) to discriminate normal from abnormal.

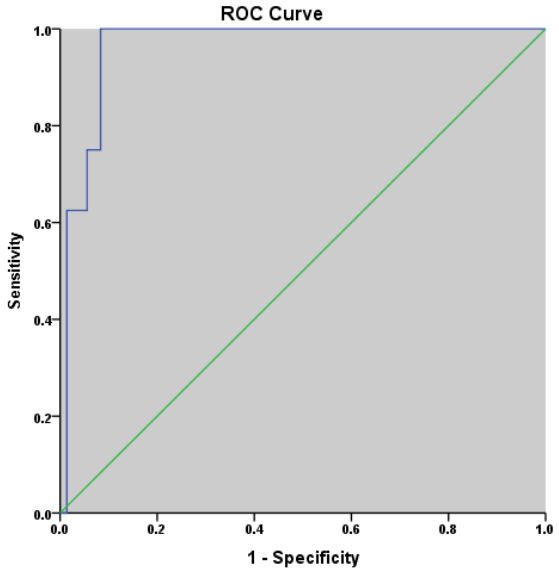

Figure 6b. ROC curve of ability of macular integrity index (MII) to discriminate normal from abnormal.

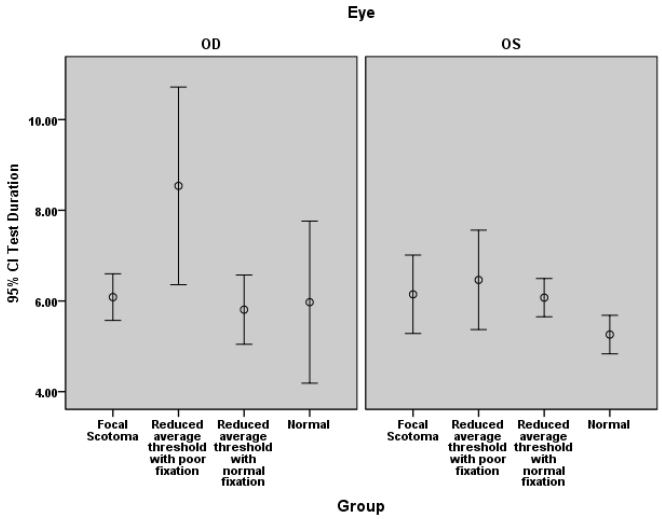

Figure 7. Test duration (minutes), by group and eye.

time compared with the other groups (Kruskal-Wallis: H(3) = 13.32, p = 0.004) and whilst there was an improvement in test duration for the left eye (6.46 minutes) compared with the right (8.54 minutes) suggesting a learning effect, this did not reach statistical significance (Mann Whitney: U = -1.81, p = 0.07). There were no significant differences in average test duration when comparing right and left eyes for the normal group (Mann Whitney: U = -0.75, p = 0.56), abnormal group (Z = -1.11, p = 0.27), or when the abnormal group was divided further (Group 1: Z = -5.28, p = 0.61; Group 2: Z = -1.81, p = 0.07, Group 3: Z = -0.46, p = 0.66).

A forward stepwise linear regression was undertaken to determine which variables might be predictive of BCVA. Any variable with a coefficient significant at the 25% level in univariate analysis was considered for inclusion in the stepwise selection process. The variables of age, gender, MII, ATS and fixation status met this criterion. Test duration did not and was therefore excluded. Each variable was individually added to age, which had the largest effect size. Only fixation status was found to be significant at 5%. Table 5 shows the results of the simple model. The remaining variables were individually added to age and fixation status. None were significant at 5%. The confounding effects of gender, MII, ATS and test duration on the model with age and fixation status were examined. ATS and test duration were found to confound effect sizes by more than 20% and added to the model. Table 6 shows the results of the final (confounding) model. The final model included age, fixation status, ATS and test duration.

The confounding model (Table 6) has an *r2* value of 0.3431 indicating that it explains 34% of the variation seen in BCVA. It has an Akaike information criterion (AIC) of 666 which indicates that the fit of the model after taking into consideration the number of variables is not quite as good as the simple model (Table 5) which excludes the confounders and had an AIC of 664. However, this difference was very

Table 5. Results from multivariate linear regression of BCVA with clustered sandwich estimator of variance (simple model – no confounders)

	Coefficient	95% CI		p-value
Age (reference: 26 – 65)				
67 – 75 yrs	-2.54	-12.35	7.27	0.607
76 – 83 yrs	-5.62	-15.33	4.08	0.252
84 – 92 yrs	-17.85	-27.83	-7.87	**0.001**
Fixation status (reference: Stable)				
Unstable	-8.83	-15.88	-1.78	**0.015**
Intercept	80.44	73.48	87.39	**<0.001**

Table 6. Results from multivariate linear regression of BCVA with clustered sandwich estimator of variance (confounding model)

	Coefficient	95% CI		p-value
Age (reference: 26 – 65)				
67 – 75 yrs	-4.16	-15.83	7.51	0.477
76 – 83 yrs	-5.75	-16.57	5.07	0.290
84 – 92 yrs	-16.97	-30.68	-3.25	**0.016**
Fixation status (reference: Stable)				
Unstable	-7.36	-15.64	0.92	0.080
ATS (reference: Normal)				
Suspect	-1.81	-17.87	14.26	0.822
Abnormal	-9.96	-20.42	0.49	0.061
Duration (reference: <5'38")				
5'38" to <6'09"	-9.96	-9.96	-9.96	-9.96
6'09" to <7'05"	-9.96	-9.96	-9.96	-9.96
≥7'05"	-9.96	-9.96	-9.96	-9.96
Intercept	82.64	76.10	89.18	**<0.001**

small. The simple model has an *r2* of 0.2627. The likelihood ratio test cannot be conducted on models with robust variance estimators, however an exploratory analysis showed no significant difference in the fit of the two models following removal of the clustering.

Logistic regression was used to analyse predictors of normal versus abnormal status. Two models were developed. The first model analyses the results of all eyes and does not include ATS (*Full sample* model). The second model includes ATS as a variable with a piecewise relationship with normal/abnormal status. That is, for all eyes with ATS lower than 25dB, the odds of having an abnormal status is 100%. As ATS increases from 25dB, the odds of having an abnormal status decrease in a linear fashion. Because the odds ratio (OR) cannot be calculated for ATS values less than 25dB, the model automatically excludes eyes in that range. Therefore the second model includes only eyes with normal ATS (*Normal ATS* model: ATS > 25 dB, *n=19*). All of the eyes with unstable fixation were classified as being abnormal and therefore no OR can be calculated for fixation status.

Any variable with any coefficient significant at the 25% level in univariate analysis was considered for inclusion in the stepwise selection process. As seen in Table 7, age, MII and test duration met this criterion for the *Full sample* model and age, MII, and ATS met this criterion for the *Normal ATS* model (Table 8). The forward stepwise process was carried out using the same method as that described for the BCVA linear regression model.

Because the only variable to be included in the final *Full sample* model was MII, the results of the final model are as seen in Table 7. Compared to those with a normal MII, the odds of having an abnormal status are 136 times higher for those with an abnormal MII (OR 136, 95%CI 15 1250, $p < 0.001$. For suspect MII: OR 8.02, 95%CI 0.44 82.43, $p = 0.180$).

Because the only variable to be included in the final *Normal ATS* model was ATS itself, the results of the regression are as seen in Table 8. For each increase in 1 dB from 25 dB, the odds of having an abnormal status decrease by 94% (OR 0.06, 95%CI 0.01 0.38, $p = 0.003$).

Table 7. Results from univariate logistic regression of MAIA status with clustered sandwich estimator of variance (full sample model)

	OR	95% CI		p-value
Age (reference: <65 years)				
≥65 years	8.33	1.20	58.03	**0.032**
Gender (reference: Male)				
Female	1.46	0.22	9.58	0.695
MII (reference: Normal)				
Suspect	6.00	0.44	82.43	0.180
Abnormal	136.00	14.80	1249.62	**<0.001**
Duration (reference: <6 mins)				
≥6 mins	1.46	1.46	1.46	1.46

Table 8. Results from univariate logistic regression of MAIA status with clustered sandwich estimator of variance (normal ATS model)

	OR	95% CI		p-value
Age (reference: <65 years)				
≥65 years	4.44	0.46	42.62	0.196
Gender (reference: Male)				
Female	1.60	0.16	15.81	0.688
MII (reference: Normal/supect)				
Abnormal	8.00	1.67	38.37	**0.009**
Duration (reference: <5m36s)				
<5m36s	1.20	0.15	9.33	0.862
ATS (continuous variable)				
Per dB	0.06	0.01	0.39	**0.003**

DISCUSSION

In this retrospective review of 48 patients (80 eyes) presenting to a private tertiary ophthalmic practice, eyes were divided into normal and abnormal clinical groups. The abnormal group was further sub-divided into three categories based on pattern of visual field loss and fixation stability. The four resulting groups differed in age, with normal patients and patients with focal scotomata being significantly younger. The groups also differed significantly with respect to BCVA, with the normal group reading on average more letters than the abnormal group. Within the abnormal groups, Groups 1 and 3 also read on average more letters than Group 2 and this was statistically significant. As expected, test times were significantly shorter in the normal group.

In using microperimetry clinically, it is important to be able to distinguish normal from abnormal results. Outcome measures were numerical ATS and MII, and did not include manufacturer's classification into 'normal', 'suspect' or 'abnormal' due to limited published normative data. The distribution of ATS scores differed significantly between normal and abnormal eyes, but did not differ significantly between the three abnormal groups. ATS was found to be potentially useful in discriminating between normal and abnormal groups. A discriminatory value for average threshold of approximately 25 dB (falling between the range of 24.6 and 26.9 dB) was identified as having the potential to differentiate normal from abnormal eyes. A ROC curve confirmed that ATS was highly reliable in differentiating normal from abnormal eyes, with the AUROC curve almost equal to one (0.988). Whilst an approximate discriminatory value for average threshold was detected, a more precise cut-off score could not be identified and no single parameter was unequivocally able to differentiate between normal and abnormal status, or between the three sub-classifications of abnormal.

Overlap was present between the results of normal and abnormal clinical groups, with the distribution of MII scores in both groups being spread across most of the possible values. Whilst MII was not found to differ significantly between the three abnormal groups, it did differ significantly between normal and abnormal eyes. A ROC curve also found MII to be highly predictive of normal versus abnormal status.

The repeatability of patient responses is an important consideration when interpreting the results of psychophysical testing. A recent study of patients with AMD tested using the MAIA microperimeter found a significant improvement in mean threshold sensitivity between the first and second microperimetry examinations, but not for subsequent examinations conducted within the same session, suggesting a learning effect.[14] Our study did not demonstrate a learning effect within a single test session, with no significant difference in test duration between first and second eyes tested, similar to results of previous research in patients with macular pathology assessed using the Nidek MP-1 microperimeter.[7]

Given the lack of a single variable capable of distinguishing between normal and abnormal macular function, the three patterns of abnormal results are potentially useful in understanding the basis of symptoms and signs. Generalised depression is probably the most difficult to interpret following a single test session, without identified focal macular pathology clinically, due to learning effect reported by others.[14]

Although the algorithm used for calculation of MII has not been published, using reverse calculations from raw data to MII, we found, as expected, a statistically significant relationship between MII and ATS when all clinical groups were combined. Forward stepwise linear regression found age, fixation status, ATS and test duration to be significant predictors of BCVA.

This study is limited by retrospective design, lack of test-retest data, lack of normative data to interpret threshold data, and lack of knowledge of the algorithms used to calculate the MII. Only a small number of eyes were included in the normal group and these controls were not age-matched. The large age range of participants (26 – 92 years) is a limitation of this study with respect to the discriminatory value for ATS. The authors acknowledge that absolute values do not account for age-related changes in threshold, and therefore a discriminatory 'range' would be more appropriate. Two different visual acuity charts were used. Whilst test standardisation would have been ideal, this was not achievable owing to retrospective design.

Microperimetry is gaining increasing interest as a clinical tool for the evaluation of visual function in retinal diseases and other ocular pathologies. It is being used as an adjunct to visual acuity testing, conventional perimetry and electrophysiology in the functional assessment of real-life patients. In the clinical setting, the main indication for microperimetry testing is in instances where dissociation exists between objective BCVA and symptoms reported by the patient, particularly with respect to difficulty reading. This type of dissociation is often apparent in patients with early or intermediate dry AMD whereby the patient has intact foveal vision but an annular area of geographic atrophy surrounding the spared fovea (ring scotoma). The advantage of microperimetry testing is the ability to document poor fixation and parafoveal microscotomata that severely reduce the usefulness of what might appear 'normal' vision, that is BVCA in the order of 20/20 (85 letters) to 20/30 (75 letters). Parafoveal loss can severely reduce reading efficiency when all other parameters are normal. This is because the perifoveal annulus assists the fovea to track letters or words on a single line. Aside from microperimetry testing, there are few ways to quantify this particular function.

Thus, the clinical usefulness of the MAIA microperimeter lies in its ability to assess parafoveal macular function where central foveal function is normal or near-normal. BCVA represents the gold standard in terms of assessing central foveal function. However, there is limited reliable testing available to assess parafoveal macular function. Whilst the Amsler grid is ideal for detecting the presence/absence of distortion, it is a subjective test and does not allow for measuring and quantifying areas of low threshold sensitivity. Other types of automated perimetry testing, such as the Humphrey Visual Field Analyser, are well placed to assess peripheral vision but not necessarily parafoveal macular function as they are not discriminatory in this small zone.

CONCLUSION

In principal, MAIA microperimetry allows for the detection of areas of paracentral dysfunction. The threshold sensitivity level (dB) is then of some second order use to detect progression over time. Fixation stability measured by the MAIA microperimeter also provides an indication of how difficult it is for the patient to achieve peak visual function. It can give an indication as to whether the patient employs a visual scanning technique to search for letters on the visual acuity chart versus being able to instantly detect the optotype or test stimulus. Thus, MAIA microperimetry is useful in the clinical setting to identify and monitor those with parafoveal macular dysfunction not identified by BCVA or conventional perimetry testing. However, it is important to recognise that the results of MAIA microperimetry need to be interpreted with some caution until more normative data is published and the methods for calculating MII are openly defined. The potential clinical use for microperimeters is likely to increase as the use of overlay SLO and OCT functionality becomes more widespread.

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Reporting for the National Disability Insurance Scheme: Incorporating the Functional Impact of Vision Impairment

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ABSTRACT

The Commonwealth of Australia has recently adopted a new innovative system of supporting people with disability; the National Disability Insurance Scheme (NDIS). Its objectives are grounded in a disability rights framework that endeavours to support people with permanent and significant disability in improved independence, community involvement, education, employment, health and well-being. To align with NDIS objectives, a major shift in perspective has occurred that moves disability service provision from a traditional funding scheme based entirely on the presence of a health condition, to one focussed on the functional impact of the person's health condition. However, despite this new approach, the capacity of a person with vision impairment to meet NDIS eligibility criteria for funding will not be judged by measures that indicate the functional impact of their vision impairment. Rather, the person's clinical measurements such as visual acuity and visual fields will be applied to predetermined criteria that have been deemed as suitable indicators of vision impairment.

This paper examined the existing professional literature that questions the application of clinical measurements to determine the functional impact of a person's vision impairment. Several models that recognise vision as a more complex entity were discussed. It is suggested that a broader approach to the assessment of a person's vision inclusive of both the clinical and functional domains, will assist ophthalmic reporting to more closely align with NDIS objectives, to enhance the support of Australians with vision impairment.

Keywords: vision impairment, disability, visual function, functional vision

INTRODUCTION

It is commonplace for clinicians to assess and then report on the health status of people in order to determine their eligibility for disability-related support funding. The implementation of the National Disability Insurance Scheme (NDIS) by the Commonwealth Government in 2012 has heralded a significant shift away from funding to support a person with disability based on the presence of a health condition, to funding based on the functional impact of their health condition. A need all across Australia now exists for assessment and reporting protocols to align with this shift. Orthoptists have always played an integral role in determining the clinical measurements of people with ophthalmic disease and vision impairment. To now ensure that this reporting remains relevant for those people with vision impairment seeking NDIS funding, consideration needs to be given to a methodology that captures the impact of vision impairment on the person's day-to-day functional capacity. This paper discussed the challenges faced in developing and implementing a new reporting methodology that assesses the person in both the functional and clinical domains. Current work in this area that might guide the development of such a methodology was also examined.

A new model of disability support funding for Australia

The Commonwealth of Australia has chosen to adopt a new approach to supporting people with disability following the detailed public enquiry in 2011 by the Australian Government Productivity Commission (APC), into long-term disability care and support.[1] The APC report stated that people with disabilities are among the most disadvantaged in Australia due to the many social and financial challenges they and their families face,[1] and concluded that 'while Australia's social security and universal health care systems provide an entitlement to services based on need, there is currently no equivalent entitlement to disability care and support services.'[1] The report findings resolved that the need existed for a new government funded national insurance scheme for Australians with disability modelled upon Medicare, and in 2012 the NDIS became a reality.

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The NDIS objectives are described in the NDIS Act 2013[2] and these include (a) supporting the independence and social and economic participation of people with disability; (b) providing reasonable and necessary supports including early intervention; (c) enabling people with disability to exercise choice and control in pursuit of their goals and the planning and delivery of their supports; (d) providing high quality and innovative supports that enable people with disability to maximise independent lifestyles and full inclusion in mainstream community; (e) raising awareness of issues that affect the social and economic participation of people with disability; (f) facilitating greater community inclusion of people with disability; and, (g) giving effect to certain obligations that Australia has as a party to such as the Convention on the Rights of the Child (1989).[2]

The NDIS will financially support people with disability, with assessment for this funding generally based on the person's functional capacity. This notion draws from the World Health Organization (WHO) framework termed the International Classification of Functions, Disability and Health (ICF). The ICF is a member of the WHO family of international classifications that complement the International Classification of Disease and Related Health Problems (ICD).[3] The ICD classifies such health conditions as disease, disorders and injury, whereas the ICF classifies the functioning and disability associated with health conditions.[3]

The ICF conceptualises disability in terms of function by de-emphasising the medical diagnosis and reframing the focus to functional outcomes.[4] Within the ICF, a person's function is conceived as a dynamic interaction between their health condition, environmental factors and personal factors,[3] and the Commonwealth Government and the states and territories have embraced this notion in developing the NDIS. As such, the recent NDIS legislation states that people with disability are considered eligible for NDIS funded support when their disability results in 'substantially reduced functional capacity to undertake, or psychosocial functioning in undertaking, one or more of communication, social interaction, learning, mobility, self-care, self-management'.[5] The planning for support funding occurs as a partnership between the person and the National Disability Insurance Agency (NDIA), with emphasis on individuality and direction by the person; in consideration and respect of the role of carers, family, community and other significant people; underpinned by the right of the person to exercise control over his or her own life; to advance the inclusion and participation in their own community; and with the goal of maximising the choice and independence of the person.[6]

To determine eligibility for disability funding, the NDIS draws on methodology that assesses the person across ten core areas of functional capacity, related to areas of activity, social and economic participation as identified in the ICF.[6] In the case of vision impairment, ophthalmic expertise is sought when it is deemed that further vision-related assessment is necessary.[6] Blais (2011) in the AMA Guide to Evaluation of Ophthalmic Impairment and Disability, comments that disability 'stems from an individual's inability to perform a task successfully because of an insufficiency in one or more areas of functional capacity'[7] and recommends that the measurement of disability impact should encompass the domains of physical, psychological, psychosocial, behavioural and contextual issues.[7] Given this recommendation, and the emphasis the NDIS places on the person's functional capacity, it is interesting to note that the current NDIS requirements for vision impairment involve reporting clinical measurements such as visual acuity and visual fields, and do not include measures grounded in functional domains.[8] These clinical measurements are applied to the NDIS criteria to determine eligibility, and the person will be funded if they have 'permanent blindness in both eyes, diagnosed and assessed by an ophthalmologist with corrected visual acuity on the Snellen Scale less than or equal to 6/60 in both eyes; or constriction to within 10 degrees or less of arc of central fixation in the better eye, irrespective of corrected visual acuity (ie visual fields are reduced to a measured arc of 10 degrees or less); or a combination of visual defects resulting in the same degree of visual impairment as that occurring in the above points'.[9] However, such reliance on clinical measurements does not occur consistently across all NDIS eligibility criteria. For example the NDIS Access Disability Requirements[9] list criteria from the Diagnostic and Statistical Manual of Mental Disorders (DSM-V) to be applied for autism. A significant component of the DSM-V assesses the functional consequences of autism,[10] and when the person with autism demonstrates a severity level of 2 (requiring substantial support), or level 3 (requiring very substantial support) on the DSM-V, they are deemed eligible for NDIS funding.[9] A similar situation exists when a person has cerebral palsy. The Gross Motor Function Classification System (GMFS)[11] is used to assess a person's ability in sitting and walking, and they are deemed eligible for NDIS funded support when they are assessed as severely affected, at level 3, 4 or 5.[9]

Translating clinical measurements to reflect a person's visual functional capacity

Clinical measurements have long been accepted as integral components of vision assessments,[12] and are commonly available for reporting purposes once a person has undergone ophthalmic investigation. However it is open to question whether or not clinical measurements are true indicators of the possible functional consequences for the person when the visual system is affected by ophthalmic disease.[7] Commonly, people with vision impairment experience fluctuations in the quality of their vision caused by variations in the levels of light and glare in their immediate environment.[13] Quality of vision can also be influenced by the level of stress and fatigue the person is experiencing,[13] resulting in reduced clarity and contrast sensitivity[14] and influencing the ability to sustain reading even when low

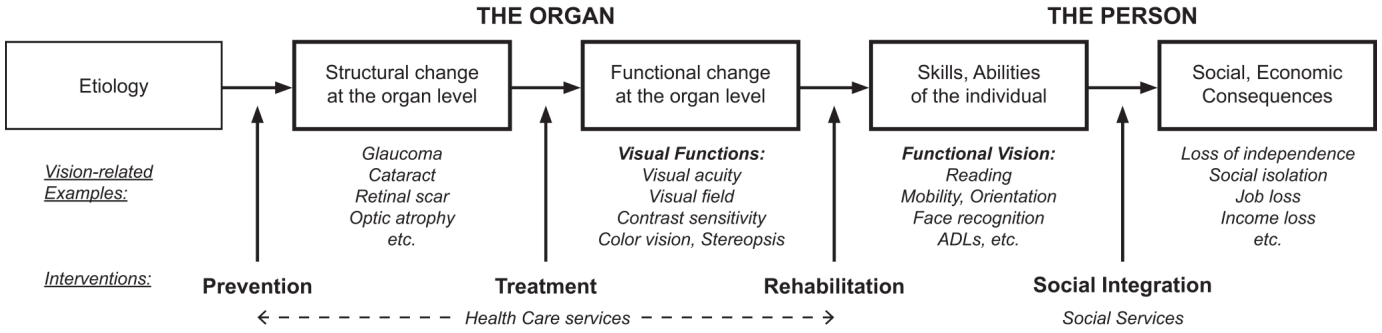

Figure 1. The four aspects of health and deficits.
('The four aspects of health and deficits' from A Colenbrander 2003.[17] Permission to reproduce given by Taylor and Francis www.tandfonline.com)

vision devices and assistive technology are used. It is widely acknowledged that clinical measurements alone do not quantify functional vision,[15] nor do they adequately explain variations in everyday performance of people with vision impairment.[16] This brings into question the suitability of the current reliance on clinical measurements alone in determining a person's eligibility for NDIS funding.

In addressing such a dilemma, Colenbrander has led in the exploration of vision from a functional perspective. Colenbrander[17] draws a clear distinction between clinical measurements and functional vision in a model that defines the four aspects of health and health deficits (Figure 1).

The model incorporates both visual function and functional vision. Colenbrander defines the former as how the eyes and the visual system function,[17] evidenced by the aggregate of precise psychophysical clinical measurements of the person's performance in such clinical tests as visual acuity, visual fields, contrast sensitivity, colour vision and stereopsis.[7] Through each test the clinician strives to determine the person's visual threshold capacity. For example when assessing visual acuity, the person is encouraged to indicate the smallest letter they can see on a vision chart, rather than just confirming that they can see a subthreshold letter size, one that is larger than the smallest letter they can see. These clinical measurements may indicate change at what Colenbrander terms the organ level (Figure 1), or the eye. These measurements are considered critical for attaining the person's diagnosis, and in grading the severity of ophthalmic disease.[7] They are also used over time to plot improvement or decline in vision and are thus indicative of the success of ophthalmic management.

Colenbrander describes functional vision as the way the person functions in vision-related activities,[17] for example facial recognition, orientation and mobility, reading and writing. In people with vision impairment, functional vision refers to their capacity to engage in vision-related activities while relying on a sustainable suprathreshold visual level that includes a comfortable performance reserve.[7] The measurement of functional vision is generally conducted in uncontrolled environments that are influenced by a variety of factors, for example light and glare, whereas visual function is measured in static, controlled environments.[18]

Colenbrander's model acknowledges the point at which the interpretation of a person's visual status shifts from reliance on clinical measurements to reliance on functional vision information, that is, when rehabilitation becomes relevant for the person. Although clinical measurements are commonly used to determine eligibility for rehabilitation, they are not considered a true indicator of the person's skills and abilities, or the social and economic consequences when measurements are suboptimal, as for example, when vision impairment exists.[19] As Colenbrander stresses 'knowing how the eye functions does not tell us how the person functions'.[20] The conclusion might therefore be drawn that clinical measurements alone do not translate to a complete understanding of a person's functional vision capacity.

The Functional Vision Score

In exploring the potential role that clinical measurements (visual function) have in estimating the person's ability to participate in generic activities of daily living (functional vision), Colenbrander[17] has proposed the calculation of a Functional Vision Score (FVS). Blais describes the FVS as a theoretical construct '… that provides a composite of the visual acuity and visual field scores for those situations in which it is helpful to distil the multifaceted reality of vision into a single number'.[7] The FVS has been incorporated into the methodology used by the American Medical Association Guides (2011) for evaluation of ophthalmic impairment and disability.[7]

To arrive at a FVS individual visual acuities and visual field outcomes are allocated an arbitrary score that follows the rule as the impairment increases, the score reduces. The uniocular score (worth 20% per eye) and binocular score (worth 60%) for both visual acuity and visual field (when available) are summed to calculate the Functional Vision Score.[17] The FVS is then subtracted from 100 to achieve the Visual Impairment Rating.[17] Colenbrander also adjusts for significant factors that affect the person's functional vision, for example reduced contrast sensitivity, glare, colour vision defects and reduced or absent binocularity, and suggests that this adjustment should be limited to

an increase in the impairment rating of the visual system (or a reduction of the FVS) by no more than 15 points.[21] This adjustment value has been selected as it potentially represents a clinically significant change, for example the equivalent of three lines on the ETDRS acuity chart. An adjustment of greater than 15 points might override the most important determinants of visual ability, visual acuity and visual fields (A. Colenbrander personal communication September, 2015).

A similar method of adjusting for the impact of significant factors has been reported in a study that attempted to develop guidelines for the evaluation of vision impairment in Korean adults.[22] The authors described adjusting by up to 15% for diplopia, accommodation error, eyelid disorders, epiphora, media opacities, cosmetic problems due to corneal opacity, aphakia and glare sensitivity. However, adjustment was not recommended for contrast sensitivity due to the unavailability of contrast sensitivity tests across locations; colour vision defects due to the rare nature of these defects and the fact that the impact on the person's generic activities of daily living (ADL) remains undetermined; and such binocularity defects as suppression and lack of stereopsis, again both of which vary in their effect on the person's ADL.[22]

Evaluating the Functional Vision Score

Several researchers have attempted to empirically evaluate the FVS, by comparing it to vision-specific measures or estimates of performance as in Quality of Life (QOL) measures.[23] QOL is known to be an important construct when determining the impact of such diseases as those that cause vision impairment. This impact can be measured by the degree to which vision-related activities of daily living are altered, ie impaired daily function becomes a proxy for visual function.[23] In evaluating the FVS developed by Colenbrander, researchers compared the FVS of 200 adults with ophthalmic disease (38% had macular disease, 18% glaucoma, 10% cataracts, 7% diabetic retinopathy, and the remaining 27% had various aetiologies) causing visual acuity of 6/18 or less and/or loss of visual field to their QOL determined using the National Eye Institute Visual Function Questionnaire 25 items (NEI VFQ 25).[23] The authors concluded that the FVS was the best predictor of QOL from the NEI VFQ scores, which '… lends evidence towards its validity as a measure of vision disability'.[23] Another study that compared the NEI VFQ 25 to FVS in 108 people with retinitis pigmentosa also concluded that vision-specific quality of life determined from the NEI VFQ 25 correlated well with the FVS.[24]

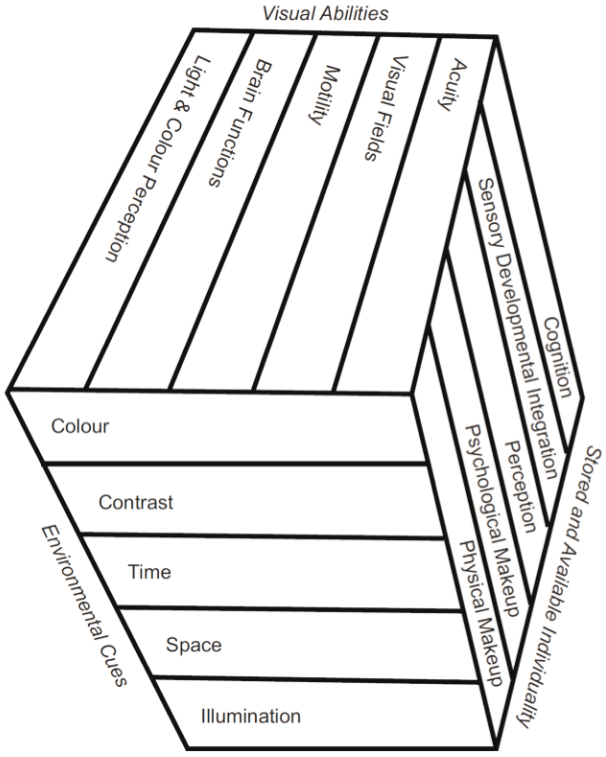

Figure 2. Model of Visual Functioning.

('Model of Visual Functioning' from AL Corn 1983.[27] Copyright 1983 by American Foundation for the Blind. All rights reserved.)

Limitations of the Functional Vision Score

Undoubtedly when compared to the clinical measurements for both the right and left eye the FVS better represents the reality of a person's visual function by considering their binocular status. However, the FVS remains constrained somewhat since it represents the person's vision within a clinical environment, rather than the person's habitual environment. Such habitual environments are visually dynamic, complex and demanding due to fluctuations in lighting, colour and contrast,[19] and present additional challenges to people with vision impairment not posed in static clinical environments. Also, the FVS does not account for the person as an individual and the ways they choose to use their vision, and cannot be applied to people who are unable to undergo standard vision assessment.

Reshaping concepts and assessments of vision

To ensure that reporting aligns with the paradigm shift that our states and territories have assented to through adoption of the NDIS, it is perhaps timely to reshape commonly held notions of vision, to formulate a broader definition that captures the complexity and individuality of the way a person sees. Several authors have attempted to deconstruct the known visual process into areas that can be potentially assessed and scored. One such author is Flom who comments that an 'individual's ability to see and function visually is determined largely by the relative contributions of a number of underlying components of vision'.[25] Further, understanding which of these components is affected by the person's vision impairment can provide insight into the way the person actually sees.[25] Jackson describes these components as resolution of high contrast detail, discrimination of low contrast features, colour differences, brightness, depth and utilisation of information from the full visual field.[26]

To broaden the concept of how a person sees, Geruschat and

Smith suggest an innovative extension of the traditional clinical measurements to include determination of the person's functional visual acuity and functional visual fields. Functional visual acuity consists of awareness acuity or the farthest possible distance that a person can detect rather than identify form; identification acuity or the farthest possible distance at which form is first correctly identified; and the person's preferred viewing distance or the most comfortable distance for a detected form.[19] Where possible, determination of the functional visual field is also recommended which includes two components, the static visual field and the preferred visual field. The static visual field is a measure of the outermost boundaries of the visual field performed in a non-clinical environment. The person is asked to describe the full extent of what they can see out to the boundaries of their visual field, whilst their eyes and head are still. The preferred visual field represents a dynamic measure of the person's regular pattern of viewing in everyday environments, determining the full extent of the person's visual awareness as they move their eyes and head. Although the functional visual acuity and functional visual field do not result in a numerical value as do the traditional clinical measurements of visual acuity and visual fields, they may provide an opportunity to better understand the person's functional use of vision and insights into the impact of their vision impairment.[19]

Corn perhaps takes a broader view by describing the three essential components of vision in her Model of Visual Functioning[27] (Figure 2). The model is composed of (a) the person's visual abilities including visual acuity, visual fields, ocular motility, brain functions, light and colour perception; (b) environmental clues including colour, contrast, time, space and illumination and (c) the person's stored and available individuality such as cognition, sensory developmental integration, perception, psychological and physical makeup. Corn discusses the need for each component to be present to the degree that will provide the person with the capacity to meet the demands of a visual task.[27] Perhaps this model begins to better represent a person's visual reality and as such can guide discussion regarding identification of the key components of visual function.

A further need exists to reshape assessment tools that address the complex nature of vision. For example, application of clinical measurements to the Corn model will only inform on one component of the person's visual function. These tools must somehow lead to establishing an understanding of the person's functional visual capacity to be meaningful for NDIS funding purposes. Recommendations by Blais begin to establish the key areas to be assessed which include the structural change at the organ level; functional change that includes visual acuity, visual fields and contrast sensitivity; the person's ability to perform such tasks as reading, mobility and face recognition; and the impact on the person's participation in society, the effect on employment and the potential for reduced quality of life.[7] Similarly Watson and Echt suggest that such a tool should assess the person's ability to discriminate detail, location and colour of objects in the environment at different distances and lighting levels, centrally and peripherally; and their ability to maintain fixation, and then to move the eyes, head and body to localise and track objects with ease and speed.[28]

Hyvärinen,[29] who has contributed extensively to paediatric ophthalmology, advocates for the assessment of four key areas when determining a child's functional visual capacity. These areas include vision for communication, vision for orientation and mobility, vision for activities of daily life, and vision for sustained near vision tasks. Hyvärinen further suggests that when a child has severe vision impairment, consideration should be given to the impact of the lack of visual information that may lead to decreased or absent initiation of communication and action.[29]

There is also merit in considering the potential that QOL assessments might play in determining a person's functional capacity, by such surveys as the NEI VFQ 25. Other measures might also warrant exploring, for example the Real Life Vision Test (RLVT) which is a vision-specific performance-based measure. The RLVT presents a person with commonly encountered tasks of daily living and grades their visual ability to complete these tasks.[12] Another form of QOL assessment that could also be contemplated is the Assessment of Function Related to Vision (AFREV)[30] which is administered by an observer and tests a spectrum of vision-related activities. The AFREV has been reported to correlate well with standard measures of visual function and certain aspects of self-reported assessments.[30] A further validated tool worthy of consideration is the Massof Activity Inventory (AI). AI is described as an adaptive visual function questionnaire that is based on a hierarchical theoretical framework.[31] The framework evaluates the person's ability to perform a task and the goals the task serves, the type of function required to achieve the goal; and the objective served by the goal. Massof comments that the AI 'can be used to take a structured and detailed functional history tailored to individual patients in a way that their responses still can be used effectively to estimate a quantitative measure of functional ability'.[31]

In summary, a review of the contemporary literature reveals the strength in a positive trend towards a broader approach to conceptualising vision and vision assessment. It reveals a foundation that could inspire a person-focused, theory-driven approach[32] to the development of a new methodology; one grounded both in the clinical and functional domains of vision.

DISCUSSION

The NDIS has been developed in the context of a person-centered, disability-focused framework to provide a strong policy base for empowerment and participation by Australians with disability.[32] The aim of this paper has been to raise an awareness of the need to develop a methodology that aligns with the main NDIS assessment objective, ie to identify core areas of functional capacity that are significantly and permanently impaired across a range of life functions, that present specific challenges for the person.[33] There is no doubt that it is convenient for clinicians to report on clinical measurements such as visual acuity and visual fields, as they are reproducible and easily measured,[7] and this remains the current NDIS expectation of reporting related to a person's vision.[9] However, the discussions in this paper have shown that clinical measurements cannot be easily translated to an understanding of a person's functional vision capacity.

To ensure that reporting aligns with NDIS objectives, it seems likely that a broader approach to vision and its assessment must be adopted. Work by Corn[27] provides thoughtful insights into the foundational components of vision that warrant consideration. A review of the literature reveals much consensus on the need to consider the person's functional vision to better understand the impact of vision impairment. Perhaps a marrying of the FVS and vision-specific performance measures should be considered as part of a solution? Additionally, the methodology that is developed will need to be suitable to apply to a population that is diverse in age, culture and capacity.

It is acknowledged that developing a new ophthalmic methodology will be challenging, but not impossible. As the NDIS is progressively rolled out across Australia it is critical that clinicians are active in the development of this methodology to ensure NDIS funding provides reasonable and adequate support to people with vision impairment.

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Amblyopia in Older Patients: Can Treatment Work?

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ABSTRACT

Aim: This paper aims to review the clinical outcomes of three patients with amblyopia who were treated beyond the critical period of 6 to 8 years of age.

Method: Three case studies are presented of patients with previously untreated monocular amblyopia, aged between 9 and 17 years. Guided by the active management and monitoring skill of an orthoptist, each patient undertook a combination of regular clinical visits for sensory and motor visual training, combined with home occlusion treatment.

Results: Each patient achieved improved visual acuity; the fastest and best result occurred in the oldest patient. All patients demonstrated the use of bifoveal fixation with a good level of sensory and motor fusion, with stereopsis in free space. Decompensation of orthophoria in one patient followed the occlusion treatment, however this then returned to binocular single vision following fusion training.

Conclusions: Amblyopia treatment in older children can result in improvement of visual acuity. Integral to the success of the process is the role of the orthoptist in motivating the patient to activate the amblyopic eye during the treatment procedures, including individual choice of the time and place for the use of the occlusion.

Keywords: amblyopia, older patients, motivation, orthoptic therapy

INTRODUCTION

Amblyopia is often seen in eye clinics[1-4] and is a condition of decreased vision that occurs following the basic mechanisms of stimulus deprivation and/or suppression.[5-7] In the presence of decreased acuity in an otherwise healthy eye it is important to note that not all patients can be treated. The vision may not respond to treatment because of secondary cortical anatomical changes[8-9] or if it does respond, there may be negative side effects, such as in older children the development of constant intractable diplopia due to lack of adequate sensory fusion.[10] In this latter situation, treatment is best not undertaken.

In order to treat amblyopia and achieve a good and stable outcome, the eye practitioner must have strong knowledge of the sensory and motor binocular interaction present in the patient, and be dedicated to an active management program to achieve and maintain the best possible visual acuity. An orthoptist in the therapeutic role has the knowledge and expertise to achieve this outcome.[11] Knowledge of binocular interaction includes appreciation of fusion tests, for both sensory and motor function as well as the appreciation of stereopsis. The ability to fuse and achieve binocular single vision indicates that improvement of vision in the amblyopic eye can occur without the complication of diplopia.[12-17]

It has been reported that amblyopia treatment can result in changes to the visual cortex, and improvement of vision can occur into adult years, though it is generally thought that treatment is most effective up to 6 to 8 years of age.[18] It is also suggested that if amblyopia is managed at a later age, treatment can take time and effort.[19] In general, a treatment program for amblyopia requires patient motivation and active practitioner supervision, both of which are vital in the successful treatment of the vision. If the patient is not motivated to achieve, or the guardian is not motivated to support the patient's effort and attendance, treatment may be unsuccessful. Unfortunately, whilst the ability to effectively motivate a patient is likely to increase as age increases and maturity develops, the ability of the vision to respond to treatment is considered to decrease.[20] Organised programs with regular supervision have been found to maximise clinical outcomes.[21] This may include occlusion therapy undertaken at home to maximise the acuity, and sensory and motor fusion training undertaken within the clinic.

This paper presents a review of the clinical outcomes of three patients with amblyopia who were treated beyond the critical period and were prescribed anti-suppression exercises to strengthen sensory fusion and vergence training to improve motor fusion. It aims to demonstrate the importance of active patient involvement and practitioner motivation in achieving a good outcome.

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CASE STUDIES

Three cases are presented (Table 1). Each patient was older than 8 years of age. When wearing their full optical correction each demonstrated a difference in vision between the two eyes of three to four lines, so were diagnosed with unilateral amblyopia. None had received previous treatment for amblyopia. All patients were confirmed to have bifoveal binocular single vision with sensory fusion demonstrated on Worth's Four Lights Test, and motor fusion demonstrated by prism fusional vergence. In all patients the accommodation near point was lower in the amblyopic eye as compared to the non-amblyopic eye. The denser the amblyopia, the lower the accommodation near point of the amblyopic eye. Treatment was introduced for each patient and is summarised in Table 2. The families of cases A and B were fully supportive of regular clinical attendance and the goal to improve the vision. Case C was enthusiastic about improving the vision. Each patient wore full optical correction and was initially prescribed 3 hours of occlusion a day, with weekly attendance at the clinic for active treatment. The orthoptic treatment involved both an active component of overcoming suppression and improving vergences, as well as a cognitive component of helping the patient to understand the process being undertaken. Once suppression was overcome and motor fusion improved the visits became fortnightly. When the vision was at a maximal level the visits were extended to once a month. There was a repetitive theme in all patients, that when the orthoptist emphasised the purpose of the treatment and the goal to be achieved, the patient motivation increased and the vision improved. Although it is difficult to scientifically measure patient motivation levels it was determined by the patient's willingness and effort to follow the instruction and exercises, as well as a measured improvement in the vision following the motivation session. In order to stimulate motivation it was found important to discuss with the patient the need to improve the vision by fully using the amblyopic eye and to convince them of the importance of the exercises.

In order to have patients actively involved in their treatment they were each asked to set a time and place for the occlusion and to undertake tasks with increasing details while actively trying to succeed in the task. Cases A and B were prescribed occlusion treatment which initially did not achieve improvement in the visual acuity (Table 2). Following a motivation session when the understanding had increased and motivation had improved the visual acuity started to increase. Case C, being older and highly motivated, responded quickly to the information and required activities from the first visit. Case B developed a

Table 1. Pre-treatment clinical test results

	Case A	**Case B**	**Case C**
Age	11 years	9 years	17 years
Diagnosis	L anisometropic & strabismic amblyopia	R anisometropic amblyopia	Refractive amblyopia
Presenting reason	Vision left eye blurred	Decreased right vision	Vision different in each eye
Ocular assessment	Fundus and media healthy	Small pinpoint cataract	Fundus and media healthy
Cycloplegic Refraction	RE +0.50 DS LE +4.00 DS	RE +2.50 DS LE +0.75/-0.25 x 180	RE -0.50 DS LE +0.50/-0.50 x 130
Prescription	RE plano LE +3.00 DS (3Δ base-out for BSV)	As above	As above
Visual acuity (with correction)	RE 6/6 LE 6/18	RE 6/30 LE 6/7.5	RE 6/7.5 LE 6/15
Fixation (visuscope)	Foveal fixation	Foveal fixation	Foveal fixation
Cover test: Near & distance	With prism: Esophoria, Without prism: L esotropia (3Δ BO)	Orthophoria	Orthophoria
Worth's Four Lights Test	With prism: 4 lights Without prism: Variable, 4 lights to left suppression	4 lights	4 lights
Stereopsis (Titmus test)	400 secs of arc	100 secs of arc	200 secs of arc
Convergence near point (RAF Rule)	5 cms	5 cms	5 cms
Accommodation to point of blur (RAF Rule)	Age normal = 14.3 D RE 20 D LE 15 D	Age normal = 15 D RE 10 D LE 15 D	Age normal = 12.3 D RE 12 D LE 11 D

tiny left esotropia and complained of associated diplopia following dissociation from the occlusion, however this resolved with fusion training. The cause of the strabismus was thought to be linked to accommodative convergence effort associated with clearing the blurred amblyopic image. The accommodation level improved as the acuity improved and achieved a level of normal for age.

DISCUSSION

These three cases demonstrated that patients between 9 and 17 years of age, therefore older children or teenagers, can successfully respond to amblyopia treatment. These cases also suggest that several factors are important to the success of the treatment. These include (i) the motivation of the patient and associated support of the family to ensure attendance at clinical sessions and to conduct treatment at home, (ii) the capacity of the visual apparatus to respond, and (iii) the role of the orthoptist to monitor progress and implement strategies to motivate the patient.

These case studies show that motivation of the patient is very important to maximise the clinical outcomes of treatment. In cases A and B when initially the patients did not fully participate, there was no improvement. When these patients became actively involved in their own treatment and gained a better understanding of the condition and its management, improvement in the visual acuity was noted. Conversely, in case C, where the motivation was high from the first visit, the response was rapid in spite of the older age and the lower potential to improve. It is suggested that attendance at the clinic for part of the treatment reinforces the ongoing training and enables strategies to be implemented to ensure the best outcome and related improvement. In order to be successful, this needs to be managed by the orthoptist.

The ability to respond to amblyopia treatment is dependent upon the plasticity of the cortical cells which is thought to be age-related, in that the cortex is more responsive when the affected person is young.[22] In these case studies the oldest patient at 17 years responded the fastest, suggesting that personal effort may be an important factor related to success. It also suggests that treatment should be considered with amblyopia patients, even when above the critical age of plasticity, of 6 to 8 years of age.

The presence of strabismus must be carefully considered when treating older patients. In case A the patient presented with a small strabismus which was controlled with a prism and in case B treatment resulted in temporary strabismus and diplopia, following the occlusion. The latter patient was managed with orthoptic fusion training which reinstated binocular single vision. In both cases the existence of a functional binocular relationship was essential to enable symptom-free single vision post treatment. Orthoptic expertise in the management of each case enabled the development of an appropriate and stable binocular relationship between the eyes to enable symptom-free single vision.

Overall, in this patient cohort the role of the orthoptist was integral to the success of the treatment. The orthoptist identified the patients whose clinical characteristics were ideal for treatment, and was involved in guiding and motivating the patients to undertake treatment and achieve set goals. Motivation is essential for the improvement of

Table 2. Treatment outcomes

	Case A	**Case B**	**Case C**
Age	11 years	9 years	17 years
Visual acuity Pre-treatment	RE 6/6 LE 6/18	RE 6/30 LE 6/7.5	RE 6/7.5 LE 6/15
Occlusion, total to light	RE 3 hours/day	LE 3 hours/day	RE 3 hours/day
Clinical treatment	Weekly clinical visits for sensory and motor training. Visits were extended to fortnightly once suppression was eliminated. Extended to monthly once vision was stabilised.	Weekly clinical visits for sensory and motor training. Visits were extended to fortnightly once suppression was eliminated. Extended to monthly once vision was stabilised.	Weekly clinical visits for sensory and motor training. Visits were extended to fortnightly once suppression was eliminated. Extended to monthly once vision was stabilised.
Initial intervention by orthoptist	Discussed the need for treatment at home and in the clinic	Discussed the need for treatment at home and in the clinic	Discussed the need for treatment at home and in the clinic
Advanced intervention by orthoptist	After 6 weeks of treatment and little change in vision: discussion about the importance of treatment; patient selected occlusion routine and agreed to try to improve.	After 4 weeks of no occlusion treatment and no change in the RVA; motivation discussion to improve vision. Patient selected time of day and place for occlusion and agreed to work.	Patient selected time of occlusion; concentrated on the image of the left eye and worked to improve it.
Outcome	Vision improved to RE 6/6, LE 6/7.5; esophoria with no suppression; stereopsis 80 secs of arc	Vision improved to RE 6/9, LE 6/7.5; orthophoria; stereopsis 100 secs of arc	Vision improved to RE & LE 6/6; orthophoria; stereopsis 60 secs of arc

clinical outcomes. This involves a thorough explanation of the condition, helping the patient to choose the activity they would use and the place of its application that would best assist the vision improvement. Additionally, the patient needs to become aware of the goal and the need to undertake the treatment on a regular basis. Following this process a positive outcome can be achieved.

CONCLUSION

Amblyopia treatment in older children can result in improvement of visual acuity. The patient's understanding of the condition and its management and setting goals for treatment is likely to be an important factor in the success of treatment. Further research should explore methods of motivation and the impact of in-clinic treatment of binocular functions on the visual outcomes of older children and teenagers treated for unilateral amblyopia.

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Selected Abstracts from the Orthoptics Australia 72nd Annual Scientific Conference held in Wellington 1 to 4 November 2015

PATRICIA LANCE LECTURE THE SPECTRUM OF POST-STROKE VISUAL IMPAIRMENT

Fiona Rowe

Stroke can have serious detrimental effects on the visual system and cortical processing including eye movement disorders, visual field impairment, low vision, perceptual and cognitive difficulties. While many visual disabilities are easily recognised and diagnosed, other, more subtle, defects remain harder to diagnose with important implications. Orthoptists working within stroke rehabilitation units or on acute stroke wards can work specifically with visual impairments related to eye movement and visual pathway systems and are experienced with requisite therapy options.

Based on recent research, the aim of this presentation is to outline the incidence and prevalence of post-stroke visual impairment, the types of visual impairment that occur in relation to low vision, eye movement disorders, visual field loss and perceptual deficits, and the impact of visual impairment. A brief review of visual rehabilitation options will be outlined along with results of recent systematic reviews of relevant interventions.

REVIEW OF THE PREVALENCE OF STRABISMUS AND FACTORS CONTRIBUTING TO VARIATION

Felicia Adinanto, Amanda French, Kathryn Rose

Strabismus presents in 2-5% of the population and is highly associated with amblyopia. It is known that those with poor vision in one eye are more likely to have pathology in the better eye later in life, contributing to the proportion of those with vision impairment with age. Literature has established that the contribution of genetics to strabismus is approximately 30% with associations between strabismus and various craniofacial and global syndromes. Environmental risk factors such as low economic status, maternal exposure to smoking, low birth weight, prematurity and admission to neonatal intensive care units have been identified as modifiable risk factors. This raises the question of whether the prevalence of strabismus has varied over decades. In order to determine this and whether the contribution of demographic characteristics of the population, such as age and ethnicity and methods of sampling and testing across populations has caused variation in the recorded prevalence of strabismus, this has been assessed by systematic analysis of the available literature.

Papers presenting the prevalence of strabismus within various population samples have been identified through database searches of PubMED and MEDLINE. Search terms included prevalence, strabismus, risk factors, school-based and population. Papers were selected for analysis if the samples were either population-based or school-based and the method of detection was by cover test by a qualified practitioner.

A TALE OF SUDDEN ONSET ESOTROPIA AND ITS MANAGEMENT

Natalie Ainscough, Deepa Taranath

A two-year-old healthy boy presented to the emergency department with sudden onset esotropia. Examination suggested likely partially accommodative esotropia or decompensating microtropia and glasses were prescribed to fully correct his hypermetropia. His left amblyopia was managed with patching therapy and three months later he underwent botox therapy to correct his residual esotropia to try and restore binocularity. Subsequently he developed an unexpected side-effect from the botox which made further management challenging. He later underwent bimedial rectus recession surgery and his follow-up over the next four months was discussed.

The diagnosis of decompensated microtropia along with its management and follow-up was discussed, highlighting the expectations of different strategies and the difficulties encountered by the unexpected outcome in this particular case.

ALBINISM AND THE ORTHOPTIST

Natalie Ainscough, Deepa Taranath

The Ocular Genetics Clinic conducted from the Women and Children's Hospital in Adelaide has been running since 2013. This clinic uses the expertise of an ophthalmologist, clinical geneticist, two orthoptists and a genetic counsellor. Within this clinic setting, the most commonly seen condition is those patients diagnosed with or suspected to have one of the many types of albinism, making up 25% of all probands seen in the 22 months between March 2013 and January 2015.

Each professional group working within the Ocular Genetics Clinic has its own defined role. The orthoptists are there to make observations, assess visual acuity, document strabismus and ocular motility deficits as well as image the eye itself. This presentation will demonstrate the orthoptic assessments, the results and how different types of albinism present in clinic. This experience is in turn valuable in identifying albinism suspects in a general paediatric ophthalmology clinic.

CAN A TWO-YEAR-OLD HAVE 45 DIOPTRES OF MYOPIA?

Natalie Ainscough, Deepa Ajay Taranath, Timothy Greenwell

A first-born healthy male child, born to nonconsanguineous caucasian parents was diagnosed to have severe neonatal primary congenital glaucoma at birth. He underwent multiple surgeries to control his intraocular pressures in addition to topical therapy. He was identified as myopic in the first two months of life, with optical correction being given before one year of age. Although he was a known high myope, he never tolerated his glasses, this factor combined with an ongoing difficulty in getting a clear neutralisation of the retinoscopy reflex, prompted the consultant to get a second opinion. His most recent refraction was at two years of age and he was found to be highly myopic, 45 dioptres bilaterally.

Ocular morphometric measurements were analysed to explain this extreme myopia and various optical corrective options were discussed. This case highlighted the various challenges in the visual assessment and optical correction of high myopia in children. Presence of congenital glaucoma and multiple surgical interventions makes it more difficult for the orthoptists and ophthalmologists managing such children.

THYROID EYE DISEASE

Jodie Attard

This was a case presentation of a patient with thyroid eye disease who was treated with intravenous methylprednisolone, including symptoms, clinical findings, management plan and response to treatment. The indications for the use and effectiveness of intravenous methylprednisolone in thyroid eye disease patients were discussed.

THE PSYCHOSOCIAL IMPACT OF REPEATED INTRAVITREAL INJECTIONS ON PATIENTS WITH NEOVASCULAR AGE-RELATED MACULAR DEGENERATION

Jessica Boyle, Meri Vukicevic, Connie Koklanis, Catherine Itsiopoulos, Gwyneth Rees

Background: Current therapy to slow disease progression in patients with neovascular age-related macular degeneration (nvAMD) entails regular intravitreal anti-VEGF injections, often indefinitely. Little is known about the burden imposed on patients by this repetitive treatment schedule and how this can be best managed. Few studies have investigated the perceptions of patients regarding treatment tolerability and satisfaction in this population. Most of these studies were small case series or examined out-dated treatments (eg PDT). The aim of this study was to explore the subjective experiences of patients undergoing anti-VEGF therapy.

Method: Forty patients (16 males, 24 females) with nvAMD undergoing anti-VEGF treatment were recruited using purposive sampling from a private ophthalmology practice and public hospital in Melbourne. Patients were surveyed using the Macular Disease Treatment Satisfaction Questionnaire and underwent semi-structured, one-on-one interviews. Topics included: treatment burden and satisfaction; tolerability; barriers to adherence; and patient education. Interviews were recorded and thematic analysis performed using NVivo 10.

Results: Patients recognised the importance of treatment to preserve eyesight, yet experienced significant emotional and practical burden from the treatment schedule. Important issues included treatment-related anxiety, financial considerations and transport burden placed on relatives/carers. Many patients were restricted to sedentary activities post-injection owing to treatment side effects. Patients prioritised treatment above other commitments, sacrificing family, travel and social life.

Conclusion: Whilst anti-VEGF injections represent the treatment method of choice for nvAMD, the ongoing treatment protocol imposes significant burden on patients. An understanding of the factors that contribute to the burden of treatment may help inform strategies to lessen its impact and assist patients to better manage the challenges of treatment.

LONG-TERM FOLLOW-UP OF A HIGH PRIORITY REFERRAL CLINIC AT THE CHILDREN'S HOSPITAL AT WESTMEAD: THE OUTCOMES

Louise Brennan, Lindley Leonard

What started as a pilot clinic in 2010 is now a busy outpatient ophthalmology clinic assessing, treating and monitoring children to achieve best visual outcome. A retrospective review of 94 children referred to a High Priority Clinic at The Children's Hospital at Westmead between 2010 and 2012 was presented. Initial visual acuity, ocular diagnosis, treatments initiated and the long-term visual outcomes were discussed.

FRAMEWORK FOR THE INTRODUCTION AND TRAINING OF LOW VISION AIDS FOR PRESCHOOL CHILDREN

Alison Byrne

There has been an increase in the amount of available adaptive and mainstream technology, which has significantly improved access for students with vision impairment to the school curriculum. Nevertheless it is important not to disregard the benefits of simple optical low vision aids (LVAs), such as magnifiers and monoculars. These LVAs are simple to use, portable, affordable and provide immediate magnification. When used proficiently, LVAs can markedly increase a student's independence, inside and outside the classroom.

It is currently widely believed that LVAs should be introduced to children once they start school. At the Royal Institute for Deaf and Blind Children (RIDBC) we introduce simple LVAs to students as young as three with positive outcomes. If children with vision impairment have a clear understanding of how LVAs function and what their benefits are, prior to starting school, it allows for an easier transition. Research shows that the type of LVA that is prescribed, when it is prescribed, and how it is introduced can significantly impact on the way a child uses LVAs in the long term.

At RIDBC a framework is being developed to provide educators with a guide on how and when LVAs can be introduced prior to starting school. The framework will be designed to encourage students to have positive and meaningful interactions with LVAs and ultimately improve their transition to school. The presentation looked at case studies where LVAs have been successfully introduced early and the impact this had on the child's transition to school.

VISION IMPAIRMENT IN CHILDREN WITH CEREBRAL PALSY

Frances Corkin

Visual disorders including strabismus, refractive error, amblyopia and cerebral visual impairment are frequently diagnosed in children with cerebral palsy. Cerebral palsy (CP) is the most common physical disability in childhood with a prevalence of 2.1 affected individuals per 1,000 live births. Cerebral palsy is a prevailing diagnosis for a number of the children seen at the Royal Institute for Deaf and Blind Children. Developmental delay as well as speech and communication impairment commonly coexists in patients with CP therefore visual responses can be difficult to evaluate and visual function underestimated. Often conventional, age-appropriate tests are not adequate to evaluate vision however assessment methods can be modified in various ways to allow for the optimal visual response. A case study was presented highlighting these common visual impairments and how positioning and other adaptations can affect visual response. Given that orthoptists are primarily responsible for evaluating vision in the eye clinic it is important that children with cerebral palsy are adequately evaluated and their vision properly understood.

THE USE OF A TOOL TO DETECT THE PRESENCE OF VISION DEFECTS IN PATIENTS DIAGNOSED WITH STROKE: PHASE 1 VALIDATION OF THE VISION SCREENING TOOL

Michelle Courtney-Harris, Neryla Jolly, Jan Steen

Aim: To report on the validation of a vision screening tool for use by all healthcare practitioners and developed to identify ocular conditions that are either pre-existing or stroke-related in stroke-affected patients.

Method: A team of vision care experts devised a screening tool to be used as part of routine stroke assessment. The screening tool was designed to detect pre-stroke eye conditions and new visual problems that may have occurred as a result of stroke. Two public hospitals in metropolitan Sydney with stroke units and no current access to on-site eyecare professionals participated in the study. Patients admitted to these stroke units for a minimum of three days were eligible for recruitment. The study had two components, the first a complete visual assessment by an orthoptist who is an experienced eyecare practitioner versus the vision screening tool administered by a health practitioner from the stroke unit. The second involved the vision screening tool administered by both the orthoptist and the stroke practitioner for comparison.

Results: Comparing vision screening using the tool and a complete vision assessment conducted by an orthoptist, the results were similar. Areas of successful detection included the use of spectacles and use of ocular medications for pre-existing conditions, which enabled patients to continue the use of pre-prescribed treatments. New ocular conditions were well recognised by stroke practitioners as they were common eye defects

associated with stroke.

Conclusion: the screening tool was effective for the detection of pre-existing eye treatments but not all pre-existing eye conditions could be specified.

ALPORT SYNDROME

Micheal Deng, James Leong, Adrian Fung

A 38-year-old myopic Chinese male was diagnosed with Alport syndrome. He presented to the clinic with bilateral rings of macular drusen. His visual acuity was right eye 6/12 pinhole 6/10 (-1.75/-1.00x120) and left eye 6/7.5-1 pinhole 6/7.5 (-1.50/-1.00x100). Past medical history included IgA nephropathy requiring a renal transplant 15 years ago and hearing loss. Alport syndrome features consist of 85% X-linked, COL4A5 gene mutations (encodes for Alpha5 chain in collagen type IV found in lens capsule, ILM, RPE, choriocapillaris basal laminae) and oculo-renal syndrome: renal failure (haematuria) and hearing loss.

EXPLORING THE PATIENT PERSPECTIVE OF CATARACT SURGICAL OUTCOMES

Vu Quang Do, Lisa Keay, Anna Palagyi, Jan Steen, Andrew White, Peter McCluskey

Background: Success of cataract surgery has traditionally been assessed by visual acuity and vision function measures. However, little is known about the relationship between these clinical outcomes and patient satisfaction following cataract extraction.

Purpose: This study aims to identify the main predictors of patient satisfaction following cataract surgery and to explore how satisfaction and quality of life is related to key visual outcomes such as visual acuity and vision-related quality of life.

Methods: The aim is to recruit 400 bilateral cataract patients aged 50 years and above currently on the cataract surgery waiting list at four public hospitals and one private clinic in Sydney. Participants will undergo comprehensive assessment of vision, self-reported visual function, quality of life and mood prior to first eye surgery, three months after first-eye surgery and three months after second-eye surgery. Satisfaction with surgery will be rated by the participant, and target post-surgical refractive status and surgical complications assessed by surgical record review.

Results: 330 participants have undergone baseline assessment as of July 2015, with 27% (n=90) having completed follow-up assessment post first-eye surgery. One-third (n=28) of participants were dissatisfied with their self-reported wait-time from initial hospital appointment to surgery date (median 6 months, range 1-18 months); median preferred waiting time was 4.5 months (range 0.5-12 months). Most participants (91%, n=82) were satisfied with their first-eye cataract surgery.

Conclusion: Eliciting the personal perspective of cataract surgery may allow eye professionals to better determine the suitability of a patient for cataract surgery, manage expectations and appropriately time surgery.

IS ECCENTRIC VIEWING TRAINING OF BENEFIT TO CHILDREN AND YOUNG ADULTS?

Kerry Fitzmaurice, Norliza Fadzil, Linda Malesic

Loss of vision can have a profound impact on a child's development, education, mobility and future employment. The impact is further compounded as the child will live with this impact for life. Macular vision loss has a profound impact on high acuity activities such as reading that are integral to education, employment and daily activities. Rehabilitation strategies to ameliorate this impact are therefore very important. The aim of this study was to investigate the impact of eccentric viewing training on visual performance of children and young adults with macular vision loss.

Method: Eight participants legally blind due to macular disease were assessed at baseline, post training and at six-months follow-up. Outcome measures were print size, reading speed, perceived and actual ADL performance. All participants were assessed for best potential eccentric viewing locus and underwent a modified eccentric viewing training based on the EccVue program.

Results and Discussion: Reading speed increased post training (mean 6.13, $p=0.05$), print size decreased (mean 1.01 log units to 0.74 post intervention, $p<0.01$) and ADL perceived ability improved (mean difference 0.51 effect size 0.88); actual ability improved (mean 0.92 and effect size 0.85). The outcomes of this study supported the use of eccentric viewing training with children demonstrating improvement on all outcome measures. Improved performance is consistent with other reports in the literature. The data also indicated participants required training to use the best potential eccentric viewing locus consistently and efficiently.

OUTCOMES FROM QUALITATIVE RESEARCH: EXPLORING CLIENT-PERCEIVED BARRIERS TO USING LOW VISION SERVICES

Julie Fitzpatrick

Low vision (due to eye disease) and living with unaddressed issues it may bring, is a growing concern and potential burden on the aging population worldwide, including in Australia. Also present, is the widely reported health issue that barriers exist to full utilisation of a range of health services, should the services exist. Evidence demonstrates that not all those requiring such healthcare see themselves as 'in need'. This issue of underutilisation of health care has also been reported for low vision rehabilitative services. This is for a range of reasons, particularly one's perception of 'need'.

The personal and financial effects of underutilising low vision rehabilitation services rank significantly in comparison with other health issues in countries where this service exists. If the barriers to use of low vision rehabilitation services could be more fully understood, this may partly help to reduce the burden of disease and improve future services for clients in this particular health industry. The goal to better understand whether this health issue exists forms the basis of this research, recently conducted in the form of investigative focus groups at Vision Australia Geelong.

CAREGIVER PERCEPTIONS ABOUT THE IMPACT OF CARING FOR PATIENTS WITH WET AGE-RELATED MACULAR DEGENERATION

Julie Heraghty, Meri Vukicevic, Rob Cummins, Bamini Gopinath, Paul Mitchell

Introduction: Family caregivers are integral to providing care to patients with chronic disease, particularly for those with wet age-related macular degeneration (wAMD). Family caregivers often provide assistance without formal training and are usually not compensated for their time. It is well documented that caregiver burden includes expending significant financial, emotional and physical effort whilst receiving no return. This in turn causes overload and stress compromising the caregiver's health and quality of life. Very few studies have explored caregiver perceptions as to what they consider important when providing care such as compassion, patience and selflessness.

Methods: A cross-sectional, self-administered survey of patients with wAMD and their carergivers was commissioned by the Macular Disease Foundation Australia. The carer survey consisted of 29 items (27 structured

Likert-scale response questions & 2 extended response questions). The aim of this study was to explore the perceptions of caregivers in relation to the most important aspects of caring, as described by their extended response answers.

Results: 643 caregiver responses were returned. Three discrete thematic networks were extrapolated from the data: i) The Impact of Caring; ii) Injections and Information and iii) Activities of Daily Living; and these were presented.

Conclusion: The findings of this study reveal an interesting and unexpected narrative into the lives of caregivers. It is quite evident that caregivers are very special people and require more support than currently available to them to prevent or ease the known issue of distress experienced as a result of caring.

RETINAL VASCULAR CALIBRE AND KIDNEY FUNCTION IN CHILDREN AND ADOLESCENTS WITH TYPE 1 DIABETES

Stuart Keel, Connie Koklanis, Meri Vukicevic, Catherine Itsiopoulos, Laima Brazionis

Aim: To investigate the relationship between retinal vascular calibre and kidney function in children and adolescents with type 1 diabetes.

Method: This was a hospital-based cross-sectional (n = 483) study of children and adolescents with type 1 diabetes. Microalbuminuria (ACR of >3.5mg/mmol in females and >2.5 mg/mmol in males) and Estimated Glomerular Filtration Rate (eGFR) (abnormal = 0 – 59 ml/min) were utilised as measures of kidney function. Retinal vascular calibre was measured by a trained grader and summarised as central retinal artery equivalent (CRAE) and central retinal vein equivalent (CRVE) using a semi-automated computer program.

Results: In this population, the mean (±SD) CRAE and CRVE were 164.21 μm (±12.55) and 232.75 μm (±17.18), respectively. Crude analysis revealed that CRAE was narrower in participants with microalbuminuria (mean 159.07 μm, ±9.93) compared to those with normo-albuminuria (mean 164.49 μm, ±12.45; p=0.006). The presence of abnormal eGFR on the other hand, was associated with lower AVR. Regression models revealed narrower CRAE was significantly associated with the presence of microalbuminuria (95% CI = 0.08/0.24, p=<0.0001). z

Conclusions: The finding of retinal arteriole narrowing in individuals with microalbuminuria highlights that retinal microvascular changes may precede a decline in kidney function. If confirmed in future longitudinal cohort and intervention studies, these findings support clinical evaluation of function in individuals with narrower retinal arterioles for earlier detection of individuals at high risk of developing nephropathy.

LONG-TERM FOLLOW-UP OF A HIGH PRIORITY REFERRAL CLINIC AT THE CHILDREN'S HOSPITAL AT WESTMEAD - BEYOND THE CLINIC

Lindley Leonard, Louise Brennan

The capacity of our High Priority Clinic to manage both newly referred patients and those already under our care led us to evaluate our service delivery. Data collected from the medical records of 94 children referred to a High Priority Clinic at The Children's Hospital at Westmead between 2010 and 2012 was further evaluated. With consideration to occasions of service and visual outcomes in relation to diagnoses and treatment, the development of discharge criteria and protocols ere presented with reference to specific cases.

THE ORTHOPTISTS' HEADACHE ... SURVIVING THE CATARACT REVOLUTION

Irene Lim, Allanah Crameri

Orthoptists of today are facing many challenges due to changes in their scope of practice but also the changes in our demographics. One of the main challenges we face is the pressure to strive for the best cataract outcomes for our patients.

This presentation looked at the evolution of cataract surgery and how it has now become a complex jigsaw puzzle (often with a missing piece) for orthoptists to put together. With the advent of new lenses, new equipment, new surgical techniques and more complicated patients, we are now faced with many more decisions to make which influence the outcome.

The presentation reinforced what is important in making these decisions and presented case studies to give an insight into the problems involved when some of these patients present to clinic.

VERGENCE TRAINING AS A TREATMENT FOR INTERMITTENT EXOTROPIA

Chiu Wai Ling

Intermittent exotropia is difficult to treat. Conventional orthoptic exercises are not very effective and the surgical effect is not long-lasting because of divergent shift. In addition to the mystery of onset, there is the day-to-day variability. While binocular single vision and fusion gradually deteriorate, patients finally lose control of the deviation completely to end up with a constant exotropia. Vergence training with a 5-dioptre prism base-out was used to train fusional reserves for 43 patients with intermittent exotropia. The control of deviation was measured by the Newcastle Control Score, binocular visual acuity and prism fusion range. The results were presented.

PAST PHYSICAL ACTIVITY AND AGE-RELATED MACULAR DEGENERATION

Myra McGuinness

Patients in the clinic often ask what they can do to prevent age-related macular degeneration. Apart from general lifestyle and nutritional advice there is no specific treatment to avert age-related macular degeneration, or prevent progression from early and intermediate to late age-related macular degeneration. Physical activity represents a lifestyle choice that is modifiable for many older persons. The association between physical activity and age-related macular degeneration was examined using 20,816 participants from the Melbourne Collaborative Cohort Study. Information on demographics, lifestyle and diet were collected between 1990 and 1994. Fundus photographs were taken an average of 11 years later. Early, intermediate and late age-related macular degeneration were detected in 4,244, 2,661 and 122 participants respectively. After adjustment for age, gender, smoking, country of birth, diet and alcohol, no association was detected between a past total recreational physical activity and early, intermediate or late age-related macular degeneration using multinomial logistic regression. For females, frequent vigorous exercise was associated with lowered odds of intermediate age-related macular degeneration, but not for males. No associations were found between vigorous exercise and early or late age-related macular degeneration.

PAPILLOEDEMA: WHEN PATHOLOGY AND 'VISUAL FUNCTION' CROSS PATHS

Danielle Morgan

Papilloedema is a condition which can affect both adult and paediatric patients. In some cases this form of optic disc swelling can cause severe and lasting vision impairment which can affect a patient's ability to carry out daily activities. An interesting case of paediatric papilloedema and its impact on visual function was discussed.

OPTICAL AIDS IN LOW VISION

Vincent Nguyen

Visual aids, including high-powered magnifying lenses and prisms are often trialled in low vision clinics. In the early stages of macular degeneration, patients are often assisted by magnifying lenses for reading. In ocular albinism where distance vision is reduced, telescopic lenses are used to assist with distance viewing. These lenses are also used in reverse to increase the content of field in patients affected by retinitis pigmentosa. Prisms made popular by the Peli Lens system, are used in expanding the visual field of patients with visual field defects caused by stroke.

High powered optical lens visual aids remain very useful among the more advanced electronic magnifying devices and the cost of these optical aids remains relatively low compared to their rival electronics.

INFLUENCES ON THE MEASUREMENT OF MOTOR FUSIONAL VERGENCE

Fiona Rowe

When describing a normal motor fusion range the values are typically provided for combined categories of heterophoria rather than individual types. It is not uncommon however to see a small motor fusion range in entirely asymptomatic heterophorias, particularly esophoria. The aim of this presentation is to evaluate and compare the fusional vergences of subjects with orthophoria, esophoria and exophoria. The literature will be reviewed and discussed in relation to factors that have an impact on the measurements of fusional vergence such as stimulus size, ocular dominance, target distance and subject age. Furthermore clinical significance of fusional vergence measures will be considered when reviewing outcomes of treatment in terms of degree of alignment.

PROGRESSION OF DIABETIC RETINOPATHY IN A RANDOMIZED CLINICAL TRIAL OF INTRAVITREAL BEVACIZUMAB VERSUS INTRAVITREAL DEXAMETHASONE FOR DIABETIC MACULAR EDEMA (THE BEVORDEX STUDY)

Sutha Sanmugasundram, Lauren Hodgson, Dania Quaterneh, Samantha Fraser-Bell, Mark Gillies, Hemal Mehta, Sanj Wickremasinghe, Lyndell Lim

Diabetic retinopathy (DR) is a common cause of severe vision loss and the leading cause of blindness in individuals between 20 and 65 years of age in developed countries. Diabetic macular oedema (DME) is the most common cause of vision loss in diabetic retinopathy. Although laser photocoagulation was the standard treatment for close to 30 years, improved treatment outcomes have led to laser treatment being surpassed by intravitreal anti-VEGF therapy as the first-line treatment for moderate to severe vision loss caused by DME. Steroidal treatment has also shown to be beneficial for DME; one such agent is the dexamethasone intravitreal implant. In this presentation the effect of bevacizumab versus dexamethasone (Ozurdex) implants on the severity of diabetic retinopathy was discussed.

Changes in DR severity will be based on reading centre assessment of colour fundus photographs using the modified Airlie House scale and the development of clinically important events defining proliferative diabetic retinopathy (PDR).

Eighty-eight eyes of 61 patients with centre-involving DME were enrolled in this study. Forty bevacizumab and 33 Ozurdex treated eyes had colour fundus images available at baseline and 24 months. Most study eyes had no change in their Airlie House DR grade regardless of treatment (62% bevacizumab, 54% Ozurdex). An improvement was noted in 20% of bevacizumab versus 30% of Ozurdex treated eyes; a deterioration was evident in 18% versus 15%, respectively. There were five bevacizumab and two Ozurdex-treated eyes, which developed PDR. In conclusion both bevacizumab and Ozurdex can improve DR severity when administered for DME.

GAZE BEHAVIOUR AMONG ORTHOPTISTS DURING OPTIC DISC EXAMINATION

Jane Scheetz, Konstandina Koklanis, Maureen Long, Meg Morris

In recent times the role of the orthoptist in glaucoma assessment has expanded with the introduction of new models of care utilising the skills of orthoptists in monitoring and co-managing patients with stable glaucoma and those considered to be suspects.

Accurate assessment of the optic nerve head is essential in the diagnosis and monitoring of glaucoma as typically, changes at the optic nerve head occur prior to any detectable visual field loss using conventional white-on-white perimetry testing. The purpose of this current study was to examine the eye movements and gaze behaviour patterns among orthoptists with varying levels of experience in glaucoma assessment during optic disc and retinal nerve fibre layer examination using optic disc photos. For each disc photo orthoptists were also asked to give a diagnosis of glaucoma likelihood.

Twenty optic disc images were selected by two glaucoma sub-specialists and included in this study. The selected images represented a range of both glaucomatous and physiologic optic disc characteristics. The eye movements of orthoptists were recorded using the Tobii T120 eye tracker. The preliminary findings of this study were presented.

TREATMENT PATTERNS IN DIABETIC MACULAR OEDEMA – A RETROSPECTIVE AUDIT: THE TREND STUDY

Tina van Tonder, Julie Morrison, Lauren Hodgson, Jonathan Tan, Lyndell L Lim, Ecosse Lamoureux, Sukhpal Sandhu

Purpose: Treatment patterns for diabetic macular oedema (DME) have evolved in recent times with the introduction of intravitreal injection therapy. Though this shift is evident in clinical practice, minimal data exists describing the change. This study aimed to describe the population presenting for DME treatment at the Royal Victorian Eye and Ear Hospital (RVEEH) over a period of five years.

Method: A retrospective chart review of patients undergoing intravitreal injection or macular laser for DME between 2009 and 2013 was performed. Data collected included demographics, clinical measures (visual acuity (VA), central macular thickness), treatments performed and adverse events.

Results: Data was extracted from 400 charts. Ninety-six percent had type 2 diabetes with a mean HbA1c of 8.5 ± 2.1%. Seventy-one percent had bilateral DME. Worse eye median VA was 6/18; 57% were male; mean age was 63.6 ± 11.4 years.

Macular laser accounted for 89.5% of all treatments in 2009, with only 8.4% intravitreal triamcinolone (IVTA) and 2.1% bevacizumab injections performed. By 2013, treatment patterns had changed, bevacizumab now accounting for 50.0% of all treatments while laser and IVTA reduced

to 46.1% and 3.9% respectively. Poor VA (<6/12) and bilateral DME significantly increased patient visits and treatments compared to good VA or unilateral disease.

Conclusion: This study has characterised the RVEEH patients being treated for DME, and their treatment change over time. There has been an inevitable shift towards intravitreal injection therapy in recent years however macular laser still has a significant part to play as a treatment of DME.

A RARE CASE OF DIPLOPIA

Shandell Wishart

A healthy 35-year-old male presented to the clinic with sudden onset of diplopia and blurry vision, examination showed an ocular motility pattern mimicking a VI nerve palsy. The rare finding was bilaterally dilated pupils which were unresponsive, denied any trauma or use of recreational drugs. An urgent MRI was performed and came back normal.

POST-REFRACTIVE CATARACTS (IN A NON-REFRACTIVE PRACTICE)

Shandell Wishart, Rebecca Page

Calculating intraocular lens (IOL) powers in patients with previous laser surgery continues to be a difficult task. This presentation aimed to highlight how a private practice in Adelaide without access to refractive lasers and often no pre-operative data tackles this situation. What the outcomes have been, where we went wrong, and some ideas of where we could improve, based on the current knowledge and resources available. The aim was to provide some tips and tricks to assist other orthoptists when faced with this challenging task.

CORTICAL VISION IMPAIRMENT iBOOK

Rosa Wright

One of the roles of orthoptists at the Royal Institute for Deaf and Blind Children is to develop resources that are useful for families and professionals working with children with vision impairment. Our newest resource is an ibook about cortical vision impairment (CVI). CVI is the most common cause of vision impairment in children in developed countries. As a consequence, various orthoptists may need to assess a child with neurological vision loss at some point in time. By definition, CVI is caused by damage to the posterior visual pathways and/or the occipital lobes, and affects the processing and perception of what is seen. The health of the eyes may still be normal. There are various characteristics specific to CVI that are not seen in children without damage to the visual areas of the brain. I will highlight the contents of the ibook including the main characteristics that are seen in children with CVI. This resource may be used to help families understand the observations that are being made as an orthoptist assesses their child.

THE ROC STUDY: COMPARING THE EFFECTIVENESS OF AN INNOVATIVE AND COMPREHENSIVE NEW EYECARE MODEL WITH USUAL CARE FOR INDIVIDUALS IN RESIDENTIAL CARE FACILITIES: MULTI-CENTERED, PROSPECTIVE AND RANDOMISED CONTROLLED CLINICAL TRIAL

Kiera Young, Marios Constantinou, Theona Nicolou, Ecosse Lamoureux

By 2025 the aging population will have grown at a rate of 3.3 times faster than the total populations and 36% of that population will need residential care. Approximately 60% of people in residential care are vision-impaired and there is no formal comprehensive eye care service model that exists to date.

The residential ocular care study proposes a new model of eye care, called Residential Ocular Care (ROC). This is a comprehensive model which includes a thorough on-site eye examination with four subsequent interventions: 1. Refraction and spectacle provision; 2. Cataract surgery; 3. Low vision rehabilitation and; 4. Referral to an ophthalmologist. This study aims to compare the effectiveness of ROC with the usual care received in aged care homes on presenting and best-corrected distance and near vision. It also aims to assess the effectiveness of ROC on various aspects of quality of life, depression, rate of falls and eyecare utilisation. The study collaborates with the Australian College of Optometry, Vision Australia, Mercy Health and Aged Care Services Australia. This presentation outlined the study methodology and progress/outcomes to date.

Named Lectures, Prizes and Awards of Orthoptics Australia

THE PATRICIA LANCE LECTURE

1988	Elaine Cornell	Home exercises in orthoptic treatment
1989	Alison Pitt	Accommodation deficits in a group of young offenders
1990	Anne Fitzgerald	Five years of tinted lenses for reading disability
1992	Carolyn Calcutt	Untreated early onset esotropia in the visual adult
1993	Judy Seaber	The next fifty years in orthoptics and ocular motility
1995	David Mackey	The Glaucoma Inheritance Study in Tasmania (GIST)
1997	Robin Wilkinson	Heredity and strabismus
1998	Pierre Elmurr	The visual system and sports perfomance
1999	Kerry Fitzmaurice	Research: A journey of innovation or rediscovery?
2005	Kathryn Rose	The Sydney Myopia Study: Implications for evidence based practice and public health
2006	Frank Martin	Reading difficulties in children - evidence base in relation to aetiology and management
2008	Stephen Vale	A vision for orthoptics: An outsider's perspective
2009	Michael Coote	An eye on the future
2010	John Crompton	The pupil: More than the aperture of the iris diaphragm
2011	Neryla Jolly	On being an orthoptist
2012	Shayne Brown	A snapshot of orthoptics from the 1960s to 2000
2013	Sue Silveira	Finding the leader within
2014	Patricia Dunlop	A life in orthoptics
2015	Fiona Rowe	The spectrum of post-stroke visual impairment

THE EMMIE RUSSELL PRIZE

1957	Margaret Kirkland	Aspects of vertical deviation
1959	Marion Carroll	Monocular stimulation in the treatment of amblyopia exanopsia
1960	Ann Macfarlane	A study of patients at the Children's Hospital
1961	Ann Macfarlane	A case history "V" Syndrome
1962	Adrienne Rona	A survey of patients at the Far West Children's Health Scheme, Manly
1963	Madeleine McNess	Case history: Right convergent strabismus
1965	Margaret Doyle	Diagnostic pleoptic methods and problems encountered
1966	Gwen Wood	Miotics in practice
1967	Sandra Hudson Shaw	Orthoptics in Genoa
1968	Leslie Stock	Divergent squints with abnormal retinal correspondence
1969	Sandra Kelly	The prognosis in the treatment of eccentric fixation
1970	Barbara Denison	A summary of pleoptic treatment and results
1971	Elaine Cornell	Paradoxical innervation
1972	Neryla Jolly	Reading difficulties
1973	Shayne Brown	Uses of fresnel prisms
1974	Francis Merrick	The use of concave lenses in the management of intermittent divergent squint
1975	Vicki Elliott	Orthoptics and cerebral palsy
1976	Shayne Brown	The challenge of the present
1977	Melinda Binovec	Orthoptic management of the cerebral palsied child
1978	Anne Pettigrew	
1979	Susan Cort	Nystagmus blocking syndrome
1980	Sandra Tait	Foveal abnormalities in ametropic amblyopia
1981	Anne Fitzgerald	Assessment of visual field anomalies using the visually evoked response
1982	Anne Fitzgerald	Evidence of abnormal optic nerve fibre projection in patients with dissociated vertical deviation: A preliminary report
1983	Cathie Searle	Acquired Brown's syndrome: A case report
	Susan Horne	Acquired Brown's syndrome: A case report
1984	Helen Goodacre	Minus overcorrection: Conservative treatment of intermittent exotropia in the young child
1985	Cathie Searle	The newborn follow up clinic: A preliminary report of ocular anomalies
1988	Katrina Bourne	Current concepts in restrictive eye movements: Duane's retraction syndrome and Brown's syndrome
1989	Lee Adams	An update in genetics for the orthoptist: A brief review of gene mapping
1990	Michelle Gallaher	Dynamic visual acuity versus static visual acuity: Compensatory effect of the VOR
1991	Robert Sparkes	Retinal photographic grading: The orthoptic picture
1992	Rosa Cingiloglu	Visual agnosia: An update on disorders of visual recognition

1993	Zoran Georgievski	The effects of central and peripheral binocular visual field masking on fusional disparity vergence
1994	Rebecca Duyshart	Visual acuity: Area of retinal stimulation
1995–7	Not awarded	
1998	Nathan Clunas	Quantitative analysis of the inner nuclear layer in the retina of the common marmoset callithrix jacchus
1999	Anthony Sullivan	The effects of age on saccades made to visual, auditory and tactile stimuli
2001	Monica Wright	The complicated diagnosis of cortical vision impairment in children with multiple disabilities
2005	Lisa Jones	Eye movement control during the visual scanning of objects
2006	Josie Leone	The prognostic value of the cyclo-swap test in the treatment of amblyopia using atropine
2007	Thong Le	What is the difference between the different types of divergence excess intermittent exotropia?
2008	Amanda French	Does the wearing of glasses affect the pattern of activities of children with hyperopic refractive errors?
2009	Amanda French	Wide variation in the prevalence of myopia in schools across Sydney: The Sydney Myopia Study
2010	Alannah Price	Vertical interline spacing and word recognition using the peripheral retina
2011	Amanda French	Comparison of the distribution of refraction and ocular biometry in European Caucasian children living in Northern Ireland and Sydney
2012	Melanie Cortes	Treatment outcomes of children with vision impairment detected through the StEPS program
2013	Jess Boyle	The accuracy of orthoptists in interpreting macular OCT images
2014	Allanah Crameri	Orthoptist-led clinics: investigating the effectiveness and efficiency of orthoptists in diabetic retinopathy screening and cataract assessment
2015	Jess Boyle	The psychological impact of repeated intravitreal injections on patients with neovascular age-related macular degeneration

PAEDIATRIC ORTHOPTIC AWARD

1999	Valerie Tosswill	Vision impairment in children
2000	Melinda Syminiuk	Microtropia - a challenge to conventional treatment strategies
2001	Monica Wright	The complicated diagnosis of cortical vision impairment in children with multiple disabilities
2005	Kate Brassington	Amblyopia and reading difficulties
2006	Lindley Leonard	Intermittent exotropia in children and the role of non-surgical therapies
2007	Jody Leone	Prevalence of heterophoria in Australian school children
2008	Jody Leone	Can visual acuity screen for clinically significant refractive errors in teenagers?
2009	Jody Leone	Visual acuity testability with the electronic visual acuity-tester compared with LogMAR in Australian pre-school children
2010	Fiona Gorski	Neurofibromatosis and associated ocular manifestations
2011	Suzy King	Understanding Sturge-Weber syndrome and the related ocular complications
2012	Jane Scheetz	Accuracy of orthoptists in the diagnosis and management of triaged paediatric patients
2013	Louise Brennan	Visual outcomes of children seen in the StEPS High Priority Clinic at The Children's Hospital at Westmead
2014	Nicole Carter	Understanding ocular motor apraxia
2015	Lindley Leonard	Long-term follow-up of a high priority referral clinic at The Children's Hospital at Westmead - beyond the clinic

THE MARY WESSON AWARD

1983	Diana Craig (Inaugural)
1986	Neryla Jolly
1989	Not awarded
1992	Kerry Fitzmaurice
1995	Margaret Doyle
1998	Not Awarded
2001	Heather Pettigrew
2004	Ann Macfarlane
2008	Julie Barbour
2010	Elaine Cornell
2011	Zoran Georgievski
2014	Mara Giribaldi

ZORAN GEORGIEVSKI MEDAL

2012	Neryla Jolly (Inaugural)
2013	Connie Koklanis
2014	Linda Santamaria
2015	Sue Silveira

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1954-5 Diana Mann
1955-6 Jess Kirby
1956-7 Mary Carter
1957-8 Lucille Retalic
1958-9 Mary Peoples
1959-60 Patricia Lance
1960-1 Helen Hawkeswood
1961-2 Jess Kirby
1962-3 Patricia Lance
1963-4 Leonie Collins
1964-5 Lucy Retalic
1965-6 Beverly Balfour
1966-7 Helen Hawkeswood
1967-8 Patricia Dunlop
1968-9 Diana Craig
1969-70 Jess Kirby
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1971-2 Jill Taylor
1972-3 Patricia Lance
1973-4 Jill Taylor
1974-5 Patricia Lance
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1979-80 Mary Carter
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1981-82 Marion Rivers
1982-3 Jill Stewart
1983-5 Neryla Jolly
1985-6 Geraldine McConaghy
1986-7 Alison Terrell
1987-9 Margaret Doyle
1989-91 Leonie Collins
1991-3 Anne Fitzgerald
1993-5 Barbara Walsh
1995-7 Jan Wulff
1997-00 Kerry Fitzmaurice
2000-2 Kerry Martin
2002-4 Val Tosswill
2004-6 Julie Barbour
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2008-10 Zoran Georgievski
2010-13 Connie Koklanis
2013-15 Meri Vukicevic

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Vol 30 1994	Alison Pitt
Vol 31 1995	Julie Green
Vol 32 1996	Julie Green
Vol 33 1997-98	Julie Green
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Vol 36 2001-02	Neryla Jolly & Kathryn Thompson
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Vol 39 2007	Zoran Georgievski & Connie Koklanis
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MELBOURNE

Discipline of Orthoptics
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